HTHKIT LINE PTR H14

HEATHKIT® MANUAL

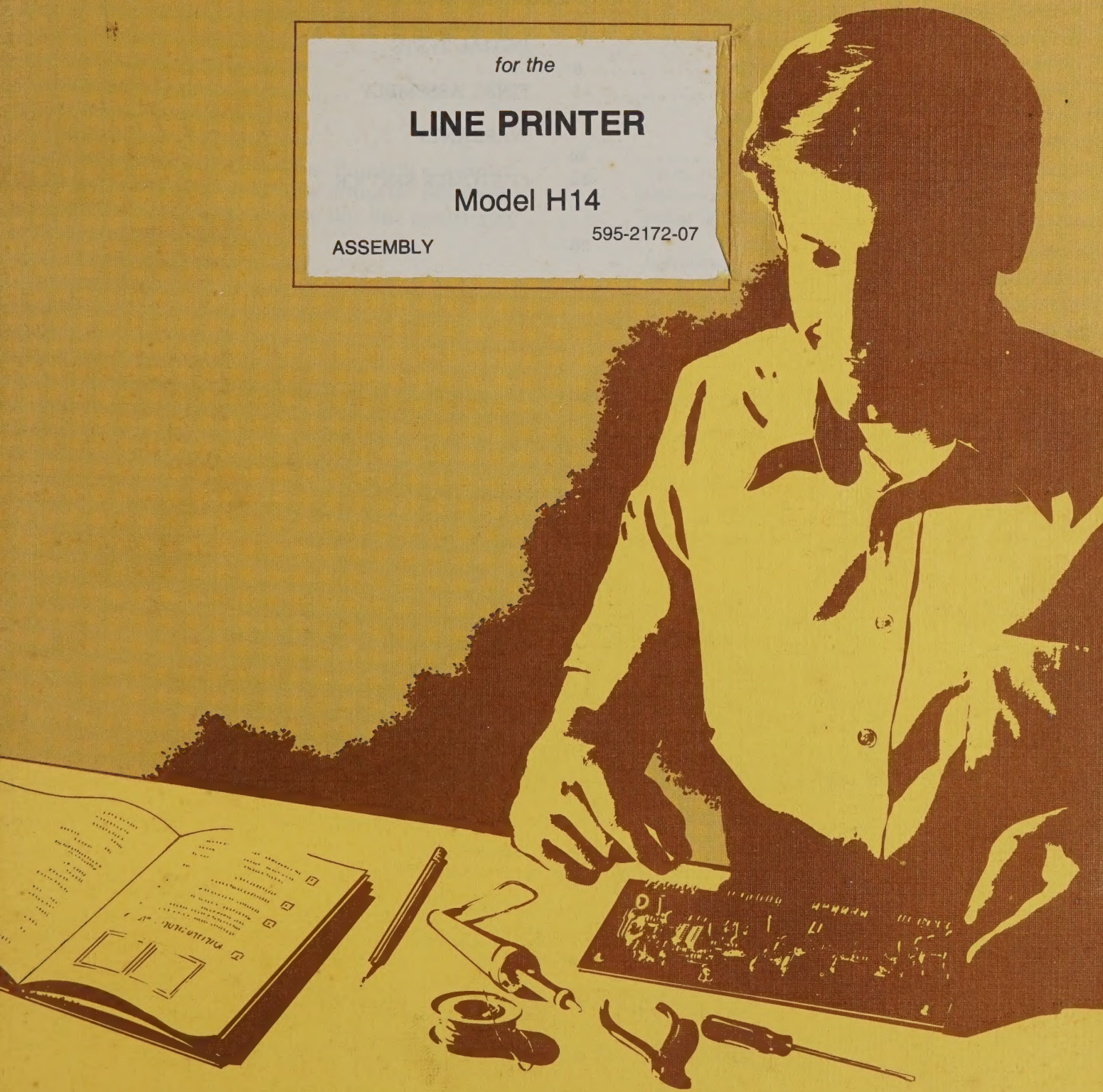
for the

LINE PRINTER

Model H14

ASSEMBLY

595-2172-07



HEATH COMPANY • BENTON HARBOR, MICHIGAN

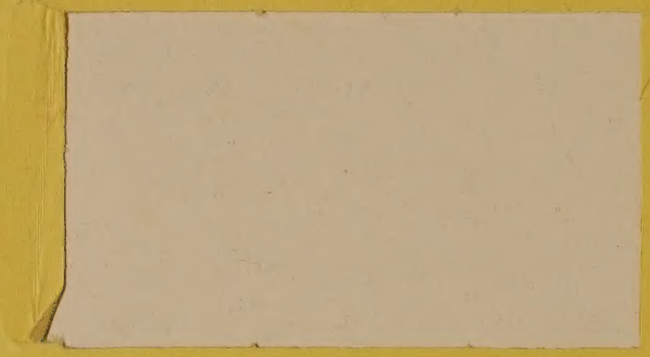
HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and Home Clocks (616) 982-3315
Television (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products (616) 982-3496
Computers (616) 982-3309



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

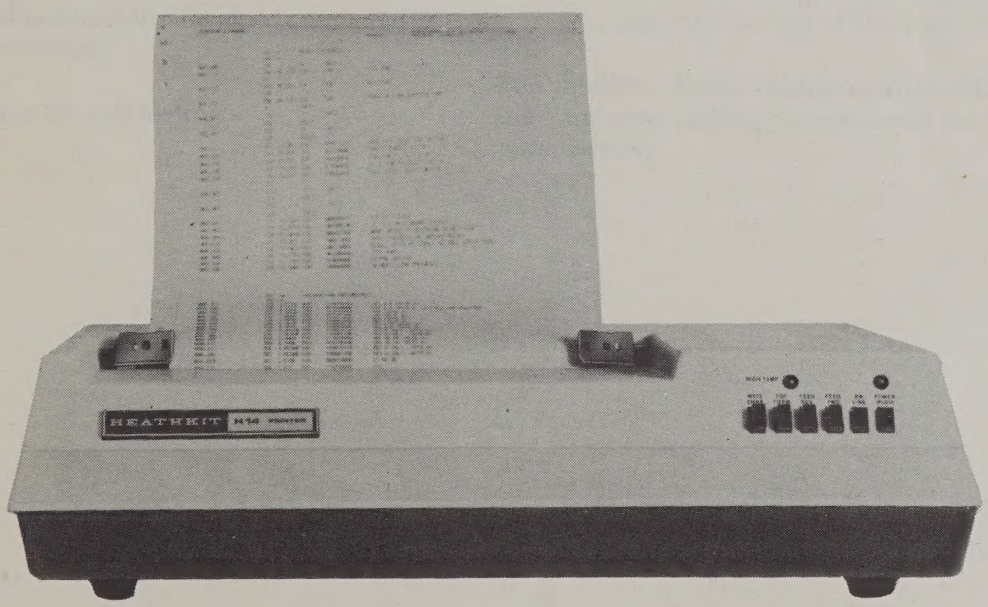
Heathkit® Manual

for the

LINE PRINTER

Model H14

ASSEMBLY 595-2172-07



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model H14 Line Printer is a compact, easy-to-built and easy-to-use computer peripheral. The following features make this line printer very versatile:

- Eight selectable baud rates.
- Operation for either 50 Hz or 60 Hz power line frequency (selectable).
- Selectable automatic line feed on receipt of carriage return.
- Provision for self-testing.
- Paper out/paper jam detector shuts down operation when printer is out of paper or if paper is jammed.
- Software selectable 10, 12.5, or 16.5 characters per inch for a maximum of 80, 96, or 132 characters per line respectively.
- Electronic form controls to feed paper forward one line, reverse one line, and feed paper to the top of the next form.

The modern, digital design assures reliability, and the handsome styling complements the Heath Computer Series.

UNPACKING INSTRUCTIONS

DO NOT UNPACK ANY PARTS UNTIL YOU ARE INSTRUCTED TO DO SO.

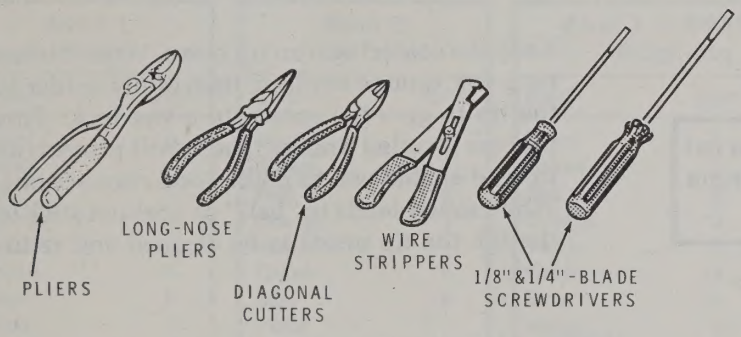
The packaging consists of the main carton which contains a package marked Pack #1 and some other parts. These other parts will be considered the Final Pack, even though they may not be marked "Final Pack."

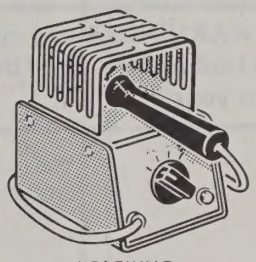
Return any part, or group of parts, that is packaged in a bag or envelope with a part number on it to its container after you identify it. Leave it there until you actually use it in a step. This will prevent intermixing of parts and help you identify parts.

ASSEMBLY NOTES

TOOLS

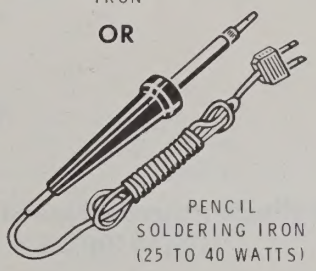
You will need these tools to assemble your kit.





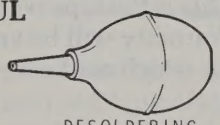
HEATHKIT SOLDERING IRON

OR



PENCIL SOLDERING IRON (25 TO 40 WATTS)

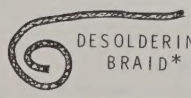
OTHER HELPFUL TOOLS



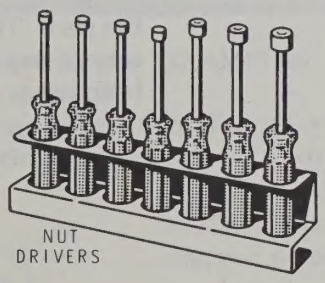
DESOLDERING BULB*



NUT STARTER (MAY BE SUPPLIED WITH KIT)



DESOLDERING BRAID*



NUT DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

 — In the Parts List,

 — At the beginning of each step where a component is installed,

 — In some illustrations,

 — In the Schematic,

 — In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

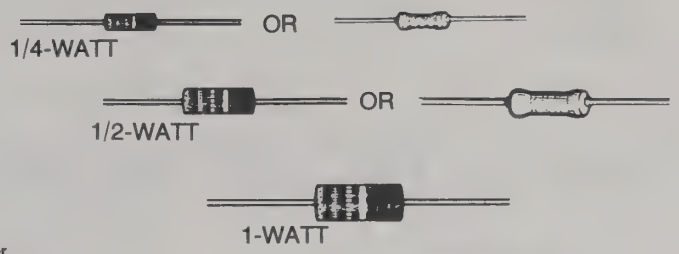
1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

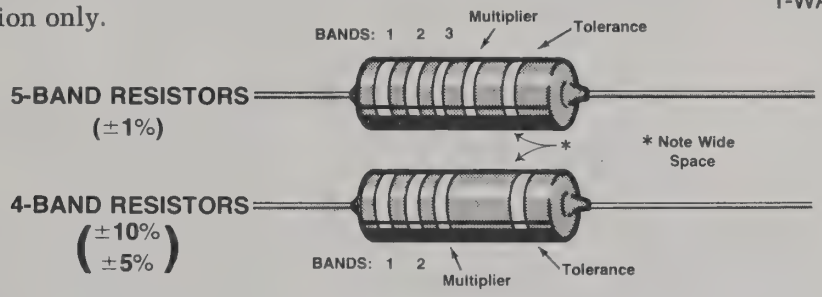
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin-core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS

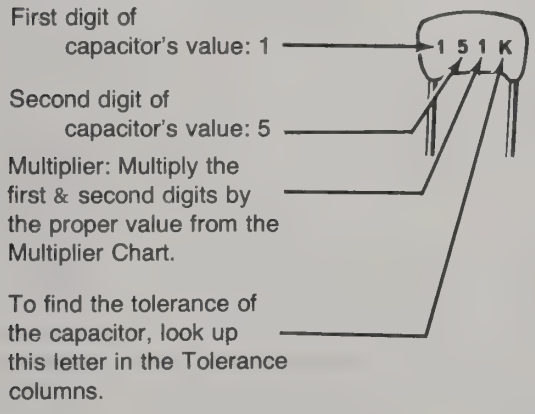
Resistors will be called out by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.





Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	±10%
Brown	1	Brown	1	Brown	1	Brown	10	Gold	± 5%
Red	2	Red	2	Red	2	Red	100	Brown	± 1%
Orange	3	Orange	3	Orange	3	Orange	1,000		
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:



EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 ×0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark

MAIN CIRCUIT BOARD

PARTS LIST

Unpack Pack #1 and check each part against the following list. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

The key numbers correspond to the numbers on the "Parts Pictorials" in the separate "Illustration Booklet."

To order a replacement part: Always include the PART NUMBER. Use the Parts Order Form furnished with the kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover. For prices, refer to the separate "Heath Parts Price List."

RESISTORS

NOTES:

1. All resistors are 5% tolerance (gold fourth band) unless otherwise noted. A fourth color band of silver indicates a 10% tolerance.

2. 1% precision resistors have five color bands. The fifth color band will be brown and will not be called out.

3. The resistors may be packed in more than one envelope. Open all resistor envelopes in this pack before you check them against the Parts List.

1/4-Watt

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-101-12	2	100 Ω (brown-black-brown)	R190, R197
A1	6-221-12	1	220 Ω (red-red-brown)	R110
A1	6-561-12	1	560 Ω (green-blue-brown)	R111
A1	6-681-12	4	680 Ω (blue-gray-brown)	R137, R139, R142, R170

Resistors (cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-122-12	38	1200 Ω (brown-red-red)	R108, R109, R112, R113, R114, R116, R117, R119, R121, R123, R124, R126, R127, R129, R131, R133, R134, R136, R152, R153, R154, R155, R156, R157, R158, R159, R161, R162, R164, R167, R168, R174, R177, R180, R185, R187, R198, R199
A1	6-222-12	4	2200 Ω (red-red-red)	R138, R141, R143, R173
A1	6-272-12	2	2700 Ω (red-violet-red)	R105, R175
A1	6-392-12	2	3900 Ω (orange-white-red)	R178, R179
A1	6-472-12	1	4700 Ω (yellow-violet-red)	R186

HEATHKIT®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (cont'd.)				
A1	6-562-12	3	5600 Ω (green-blue-red)	R184, R188, R196
A1	6-103-12	1	10 kΩ (brown-black-orange)	R165
A1	6-183-12	1	18 kΩ (brown-gray-orange)	R166
A1	6-683-12	1	68 kΩ (blue-gray-orange)	R106
A1	6-104-12	1	100 kΩ (brown-black-yellow)	R151
A1	6-105-12	2	1 MΩ (brown-black-green)	R182, R183
Precision Resistors, 1%, 1/4-Watt				
A2	6-2109-12	1	21 Ω (red-brown-black gold)	R192
A2	6-4709-12	1	47 Ω (yellow-violet-black-gold)	R193
A2	6-3300-12	1	330 Ω (orange-orange-black-black)	R194
A2	6-1001-12	1	1000 Ω (brown-black-black-brown)	R171
A2	6-6001-12	1	6000 Ω (blue-black-black-brown)	R172
A2	6-1002-12	1	10 kΩ (brown-black-black-red)	R191
1/2-Watt				
A3	6-391	1	390 Ω (orange-white-brown)	R148
A3	6-471	8	470 Ω (yellow-violet-brown)	R101, R102, R103, R104, R107, R165, R176, R181
A3	6-511	1	510 Ω (green-brown-brown)	R149
Other Resistors				
A4	6-331-1	7	330 Ω, 1-watt, 10% (orange-orange-brown)	R115, R118, R122, R125, R128, R132, R135
A4	3-2-2	1	0.33 Ω, 2-watt (orange-orange-silver)	R169
A5	3-26-5	1	390 Ω, 5-watt	R189
CONTROL				
A6	11-90	1	200 Ω	R195
CAPACITORS				
B1	21-6	1	27 pF ceramic	C108
B1	21-722	7	330 pF ceramic	C101 through C107
B1	21-36	1	.002 μF ceramic	C110
B1	21-143	3	.05 μF ceramic	C109, C111, C112
B1	21-199	9	0.1 μF ceramic	C114, C116, C117, C118, C119, C121, C122, C123, C124

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Capacitors (Cont'd.)				
B2	25-220	1	10 μF (10 M) tantalum	C115
B3	25-262	1	250 μF electrolytic	C126
B3	25-901	1	220 μF electrolytic	C113
B4	25-929	1	39 μF (39 k) electrolytic	C127
B4	25-824	1	500 μF electrolytic	C125
DIODES				
C1	56-50	1	DO-7 zener (3.6 V)	ZD109
C1	56-56	7	1N4149	D101, D102, D111, D112, D113, D126, D127
C1	56-605	7	1N4746A (18 V) zener	ZD101, ZD102, ZD103, ZD104, ZD105, ZD106, ZD107
C1	56-612	1	1N5229 (4.3 V) zener	ZD108
C1	57-42	6	3A1	D118, D119, D121, D122, D123, D125
C1	57-65	8	1N4002	D103, D104, D105, D106, D107, D108, D109, D124,
C2	412-616	2	LED	LED101, LED102
TRANSISTORS				
NOTE: Transistors are marked for identification in one of the following four ways: 1. Part number. 2. Type number. 3. Part number and type number. 4. Part number with a type number other than the one listed.				
D1	417-263	7	SJE607	Q104, Q106, Q108, Q110, Q112, Q114, Q116
D2	417-801	1	MPSA20	Q128
D2	417-864	9	MPSA05	Q103, Q105, Q107, Q109, Q111, Q113, Q115, Q126, Q127
D2	417-865	4	MPSA55	Q101, Q124, Q125, Q129
D2	417-897	1	Selected	Q102
D3	57-612	3	T2302F or H103SG triac	Q117, Q118, Q119

SWITCHES

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
E1	60-621	1	Switch assembly	SW102
E2	64-838	1	Pushbutton switch	SW101

INTEGRATED CIRCUITS

NOTES:

1. Integrated circuits are marked for identification in one of the following four ways:
 A. Part number.
 B. Type number. (This refers only to the numbers; the letters may be different or missing.)
 C. Part number and type number.
 D. Part number with a type number other than the one listed.
2. Some of the IC's may be packed in conductive foam. Do not remove the IC's from the foam until you are instructed to do so.

F1	442-616	1	LM3302N or LM2901	U117
F1	443-6	1	SN7474N	U107
F1	443-73	3	SN7416N	U114, U115, U116
F1	443-728	1	SN74LS00N	U108
F1	443-794	1	SN75188N or 1488	U104
F1	443-795	1	SN75189N or 1489	U103
F2	443-721	2	2112-2 P7810	U112, U113
F3	443-791	2	SN74LS244N	U109, U110
F3	443-805	1	SN74LS273N	U111
F4	443-808	2	4N26	U101, U102
F5	443-874	1	8250D	U105
F5	444-31	1	3870 (custom)	U106

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
G1	75-159	3	Transistor insulator	
G2	260-65	2	Fuse clip	
G3	404-536	1	4 MHz crystal	Y101
G4	421-63	1	6/10-ampere slow-blow fuse	F101
G5	432-921	1	3-pin connector	S103
G6	432-932	21	Connector pin	J101 through J119, TP101, TP102
G7	432-1039	1	15-pin connector	S102
G8	434-253	2	40-pin IC socket	
G9	434-298	8	14-pin IC socket	
G10	434-299	3	16-pin IC socket	
G11	434-311	3	20-pin IC socket	
G12	434-315	2	6-pin IC socket	
	490-185	1	Solder braid	
G13	490-189	1	IC puller	

PARTS FROM FINAL PACK

85-2147-2	1	Circuit board
340-2	8"	Bare wire (in the wire pack)
346-21	4"	Small clear sleeving
587-260	1	Parts Order Form
	1	Assembly Manual (See Page 1 for part number)
		Solder

STEP-BY-STEP ASSEMBLY

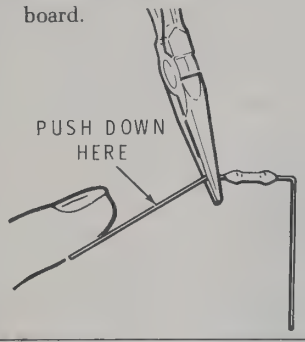
Refer to the Modification Instructions and perform the steps in PART I.

START

In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

() Position the circuit board as shown with the printed side up.

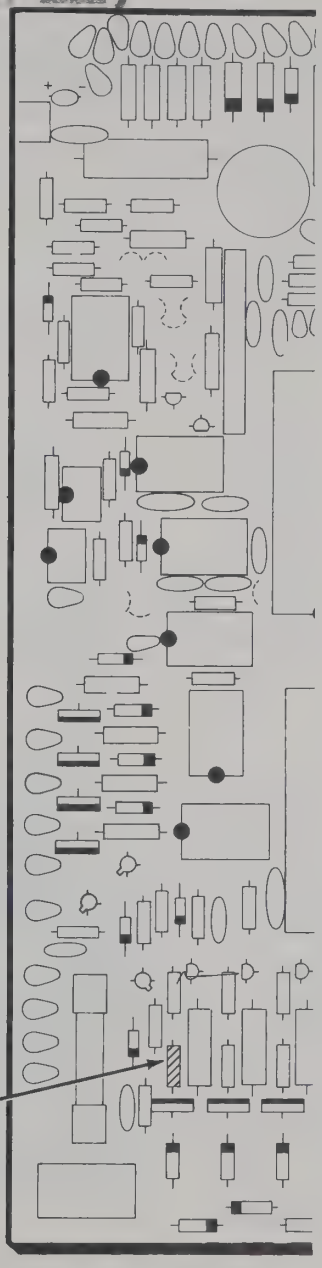
() R136: Hold a 1200 Ω (brown-red-red) resistor as shown and bend the leads straight down with long-nose pliers to fit the hole spacing on the circuit board.



() Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

() Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.



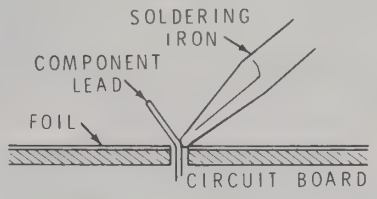


PICTORIAL 1-1

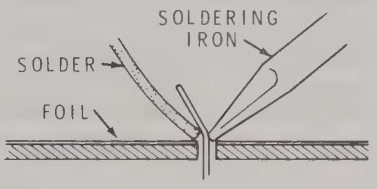
CONTINUE

() Solder the resistor leads to the circuit board as follows:

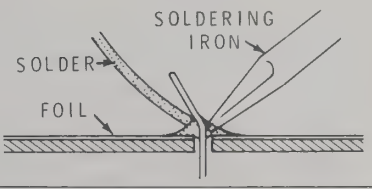
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



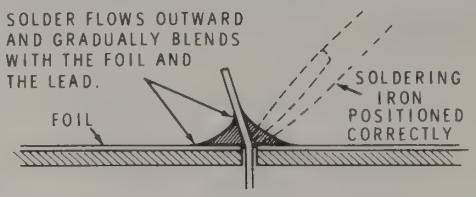
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



() Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

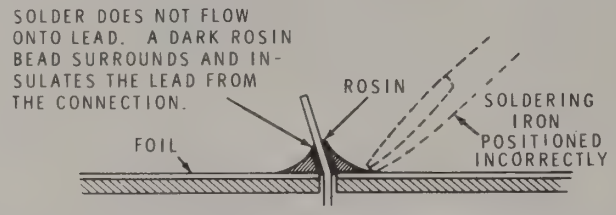
() Check each connection. Compare it to the illustration on Page 12. After you have checked the solder connections, proceed with the assembly on Page 13. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

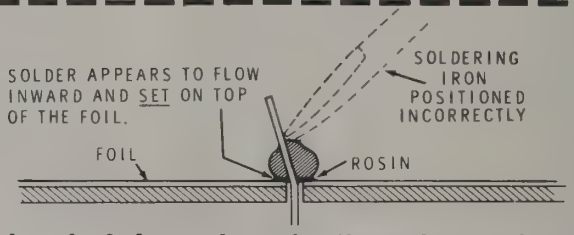


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



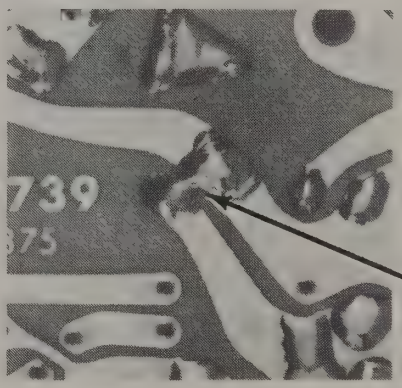
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



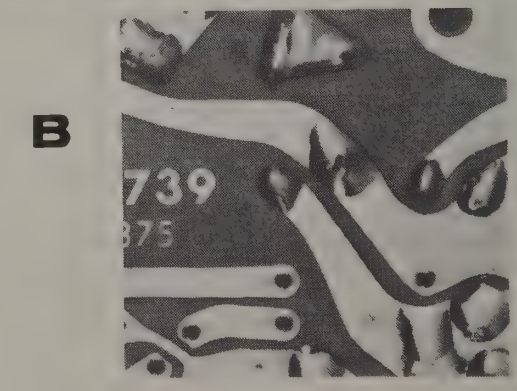
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

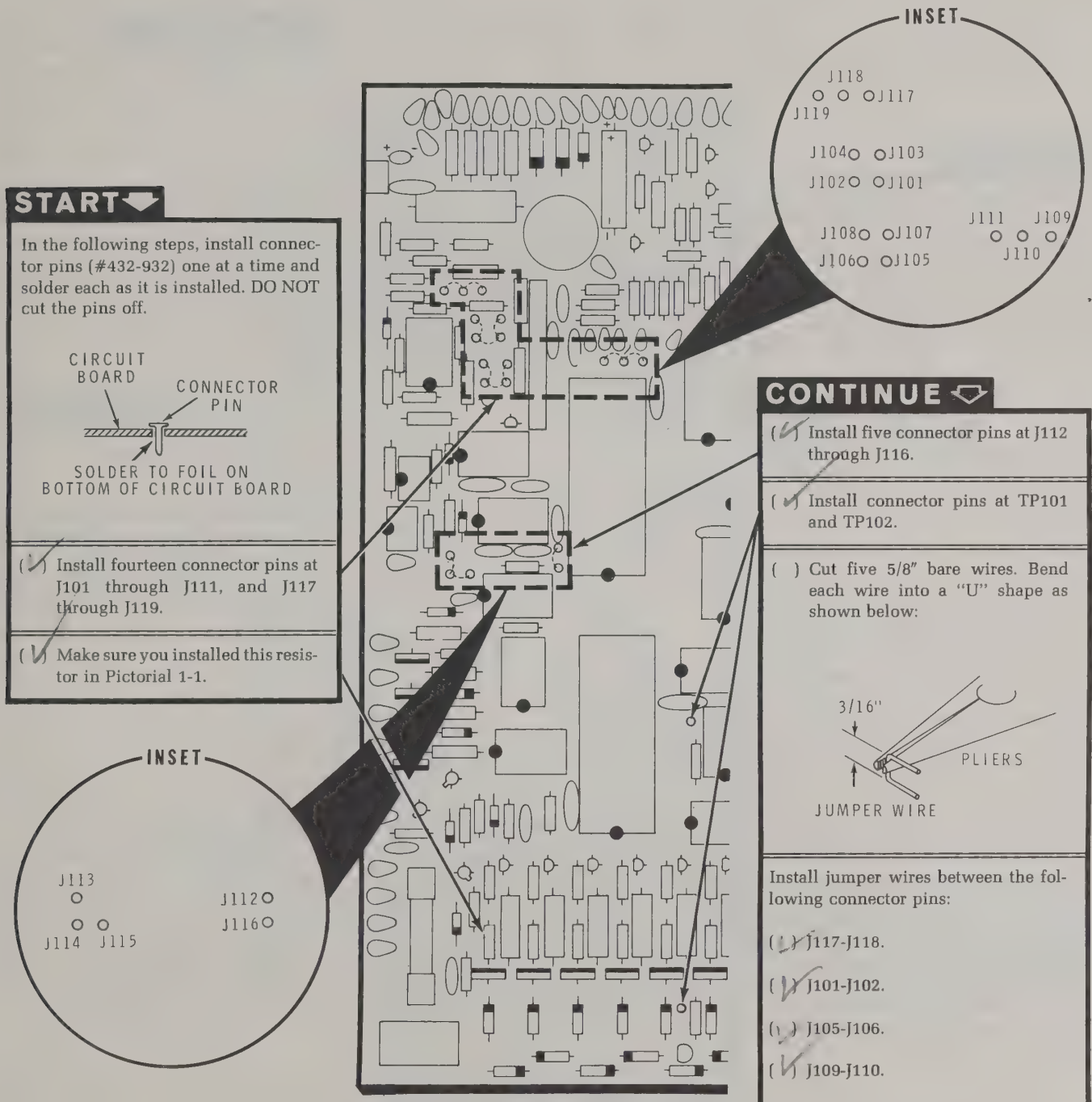
SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.





START

In the following steps, install connector pins (#432-932) one at a time and solder each as it is installed. DO NOT cut the pins off.

(✓) Install fourteen connector pins at J101 through J111, and J117 through J119.

(✓) Make sure you installed this resistor in Pictorial 1-1.

CONTINUE

(✓) Install five connector pins at J112 through J116.

(✓) Install connector pins at TP101 and TP102.

() Cut five 5/8" bare wires. Bend each wire into a "U" shape as shown below:

Install jumper wires between the following connector pins:

(✓) J117-J118.

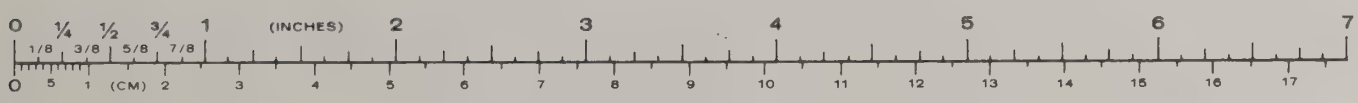
(✓) J101-J102.

(✓) J105-J106.

(✓) J109-J110.

() J114-J115.

PICTORIAL 1-2



START

Install eight 470 Ω (yellow-violet-brown) **1/2-watt** resistors at the following locations.

() R165

() R181

() R176

() R101

() R102

() R104

() R107

() R103

() Solder the leads to the foil and cut off the excess lead lengths.

() R110: 220 Ω (red-red-brown).

Install four 680 Ω (blue-gray-brown) resistors.

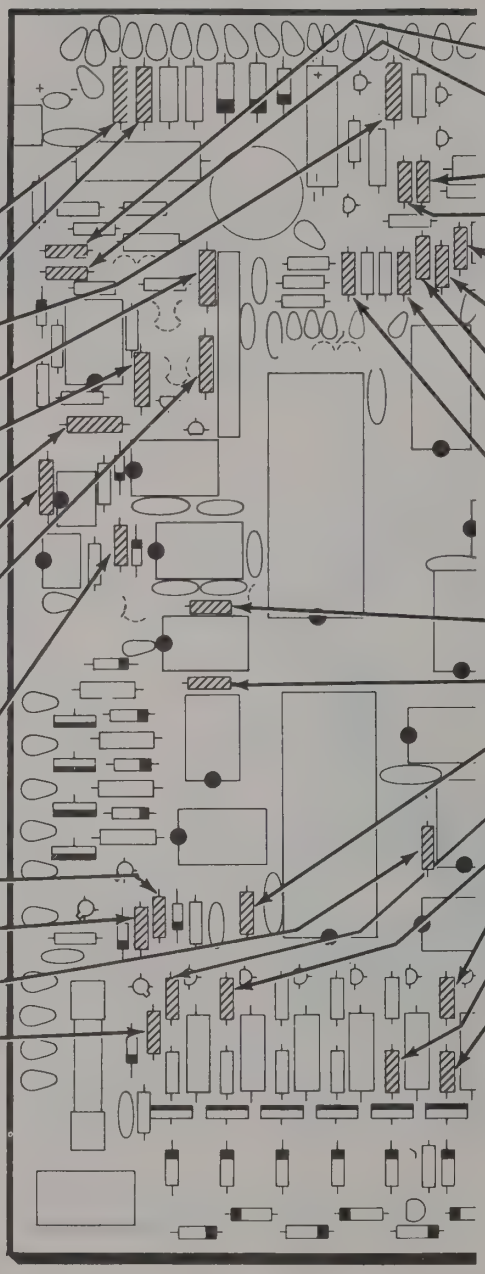
() R142

() R137

() R170

() R139

() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

Install thirty-seven 1200 Ω (brown-red-red) resistors at the following locations.

() R185.

() R187.

() R174.

() R167.

() R158.

() R156.

() R157.

() R152.

() R155.

() Solder the leads to the foil and cut off the excess lead lengths.

() R108.

() R177.

() R109.

() R134.

() R121.

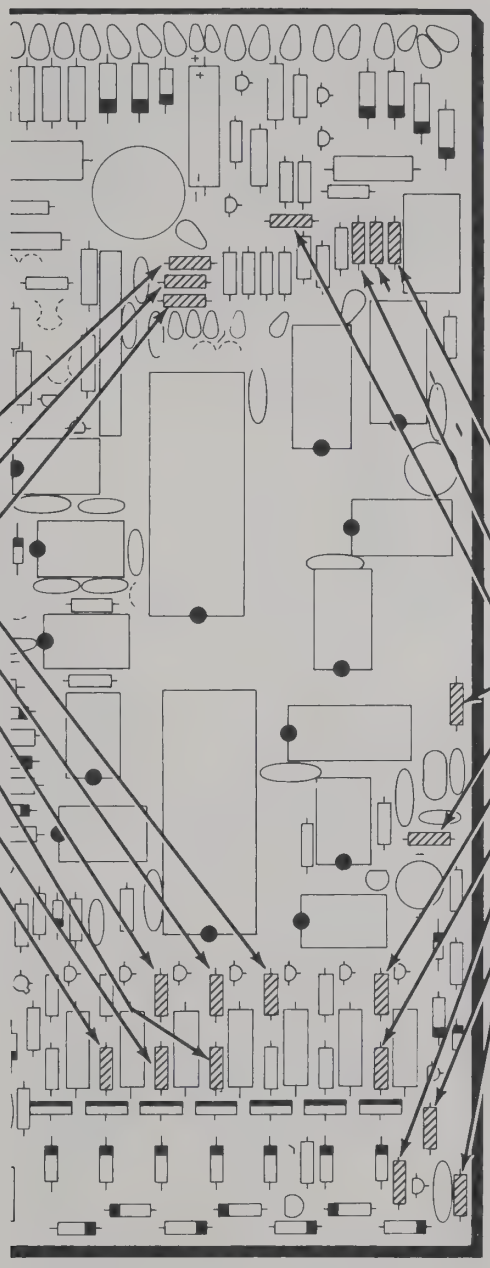
() R124.

() R133.

() R126.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-3



START

() R164
() R153
() R154
() R131
() R117
() R127
() R119
() R129
() R123

() Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

() R161.
() R162.
() R159.
() R168.
() R112.
() R113.
() R114.
() R116.
() R180.
() R198.
() R199.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-4

START

() R186: 4700 Ω (yellow-violet-red).

Install two 5600 Ω (green-blue-red) resistors.

() R184

() R188

Install two 1 MΩ (brown-black-green) resistors.

() R183

() R182

Install two 3900 Ω (orange-white-red) resistors.

() R178

() R179

() Solder the leads to the foil and cut off the excess lead lengths.

() R106: 68 kΩ (blue-gray-orange).

() R105: 2700 Ω (red-violet-red).

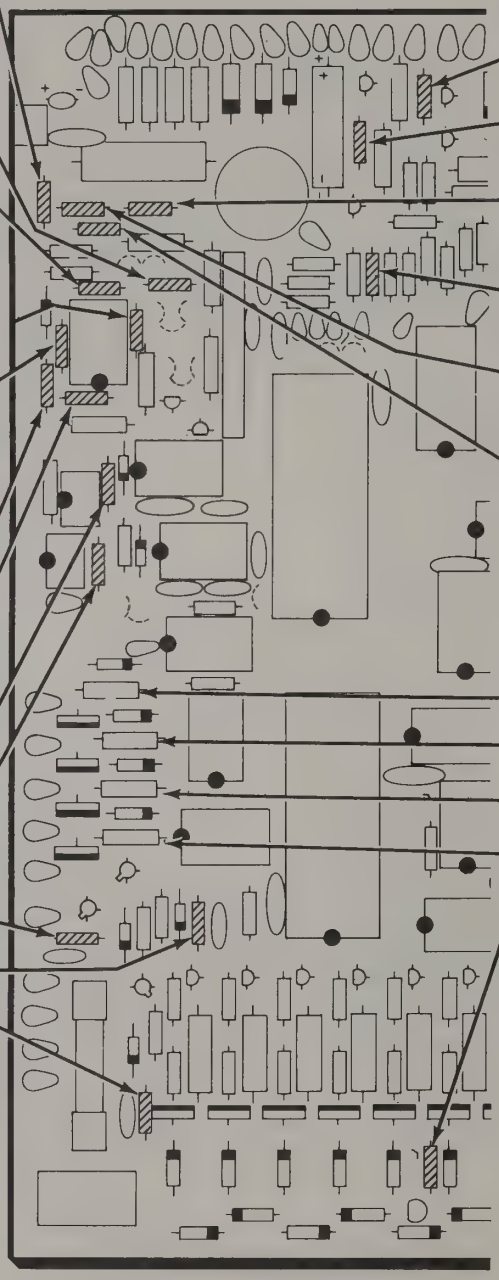
Install three 2200 Ω (red-red-red) resistors.

() R138

() R143

() R141

() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

() R173: 2200 Ω (red-red-red).

() R171: 1000 Ω, 1% (brown-black-black-brown)

() R193: 47 Ω, 1% (yellow-violet-black-gold).

() R165: 10 kΩ (brown-black-orange).

() R194: 330 Ω, 1% (orange-orange-black-black).

() R192: 21 Ω, 1% (red-brown-black-gold).

() Solder the leads to the foil and cut off the excess lead lengths.

Do not install resistors at the following locations.

R145.

R144.

R147.

R146.

() R196: 5600 Ω (green-blue-red).

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-5

START

() R149: 510 Ω, 1/2-watt, 5% (green-brown-brown). NOTE: Your circuit board may be marked 390 at this location.

() R148: 390 Ω, 1/2-watt, 5% (orange-white-brown).

() R191: 10 kΩ, 1% (brown-black-black-red).

Install seven 330 Ω (orange-orange-brown), 1-watt, 10% resistors.

() R115

() R125

() R132

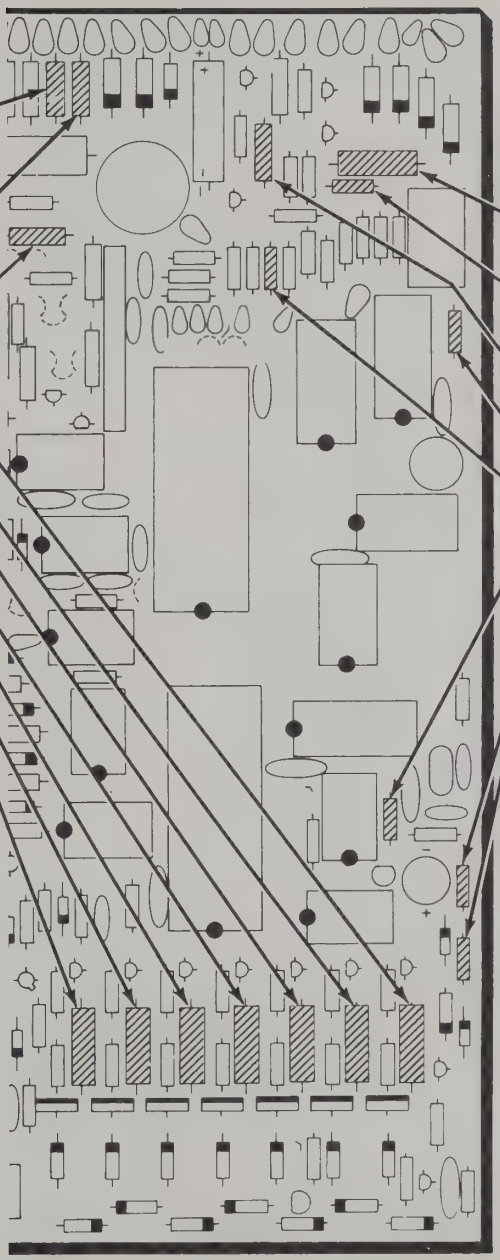
() R118

() R128

() R122

() R135

() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

() R169: 0.33 Ω (orange-orange-silver), 2-watt.

() R175: 2700 Ω (red-violet-red).

() R172: 6000 Ω, 1% (blue-black-black-brown).

() R166: 18 kΩ (brown-gray-orange).

() R151: 100 kΩ (brown-black-yellow).

() R111: 560 Ω (green-blue-brown).

Install two 100 Ω (brown-black-brown) resistors.

() R190.

() R197.

() Solder the leads to the foil and cut off the excess lead lengths.

NOTE: The 390 Ω, 5-watt resistor will be installed later.

PICTORIAL 1-6

START

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. A DIODE WILL NOT WORK IF IT IS INSTALLED BACKWARDS. See Detail 1-7A at the bottom of this column.

If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass.

() ZD108: 1N5229 zener diode (#56-612).

Install five 1N4149 diodes (#56-56).

() D102

() D101

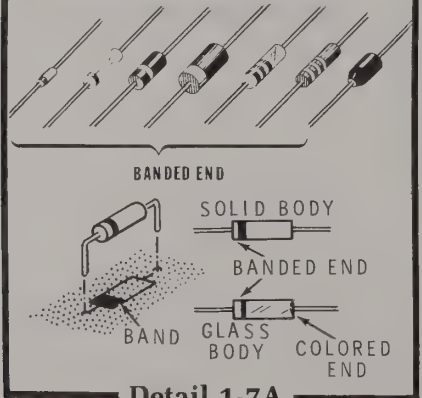
() D113

() D111

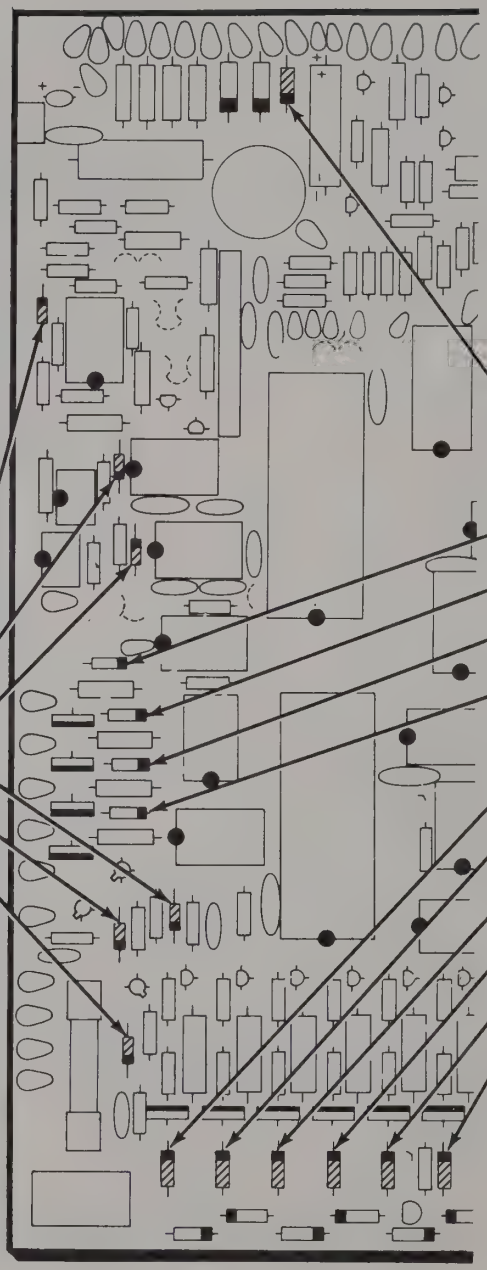
() D112

() Solder the leads to the foil and cut off the excess lead lengths.

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



Detail 1-7A



PICTORIAL 1-7

CONTINUE

() D124: 1N4002 diode (#57-65).

Do not install parts at the following locations.

D115.

D114.

D117.

D116.

Install six 1N4002 diodes (#57-65).

() D109.

() D105.

() D107.

() D104.

() D108.

() D106.

() Solder the leads to the foil and cut off the excess lead lengths.

START

Install two 1N4149 diodes (#56-56).

() D126

() D127

() ZD109: DO-7 zener diode (#56-50).

() D103: 1N4002 diode (#57-65).

Install seven 1N4746A zener diodes (#56-605).

() ZD104

() ZD101

() ZD102

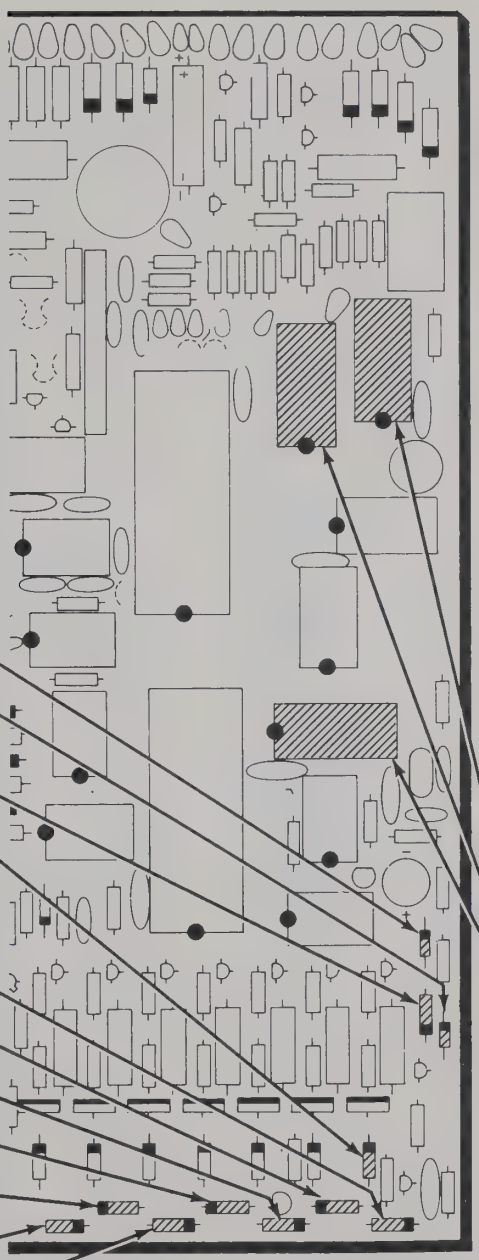
() ZD106

() ZD105

() ZD107

() ZD103

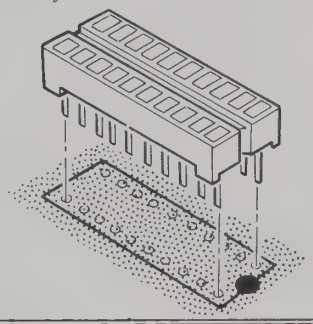
() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

NOTE: When you install an IC socket, use the following procedure:

1. Be sure all the pins are straight.
2. Insert the pins into the holes.
3. Turn the circuit board over and be sure the correct number of pins extend from the board. If not, one or more pins may be bent under the socket. Remove the socket, straighten the pins, and reinstall the socket.
4. Solder the pins to the foil as you install each socket.



Install three 20-pin IC sockets at the following locations:

() U110.

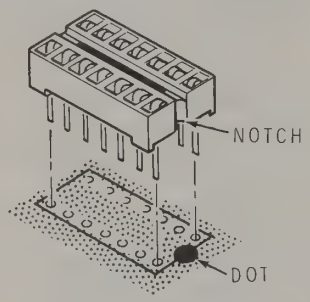
() U109.

() U111.

PICTORIAL 1-8

START

NOTE: Make sure the notch on each IC socket is positioned as shown when you install the following IC sockets.



Install 14-pin IC sockets at:

() U117.....

() U104

() U103

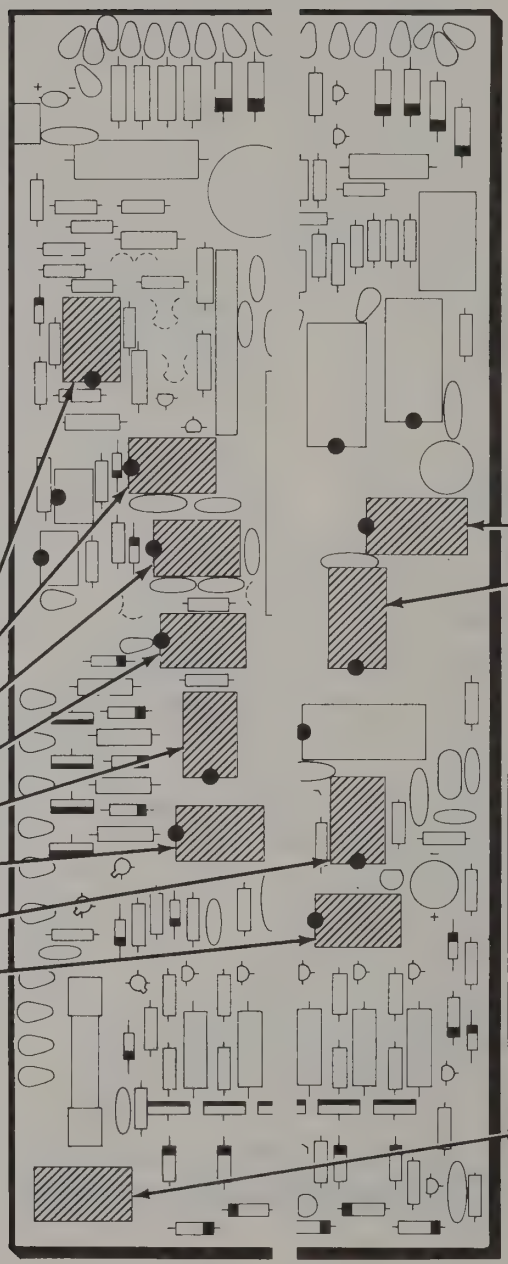
() U107

() U116

() U115

() U108

() U114

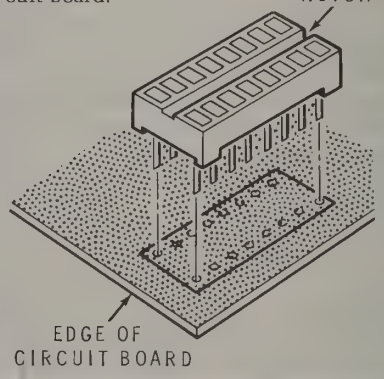


CONTINUE

() 16-pin IC socket at U113.

() 16-pin IC socket at U112.

NOTE: When you install the following IC socket, position the notch on the socket away from the edge of the circuit board.

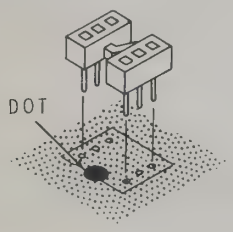


() 16-pin IC socket at S101.

PICTORIAL 1-9

START

NOTE: When you install the next two IC sockets, make sure the sockets are positioned as shown:



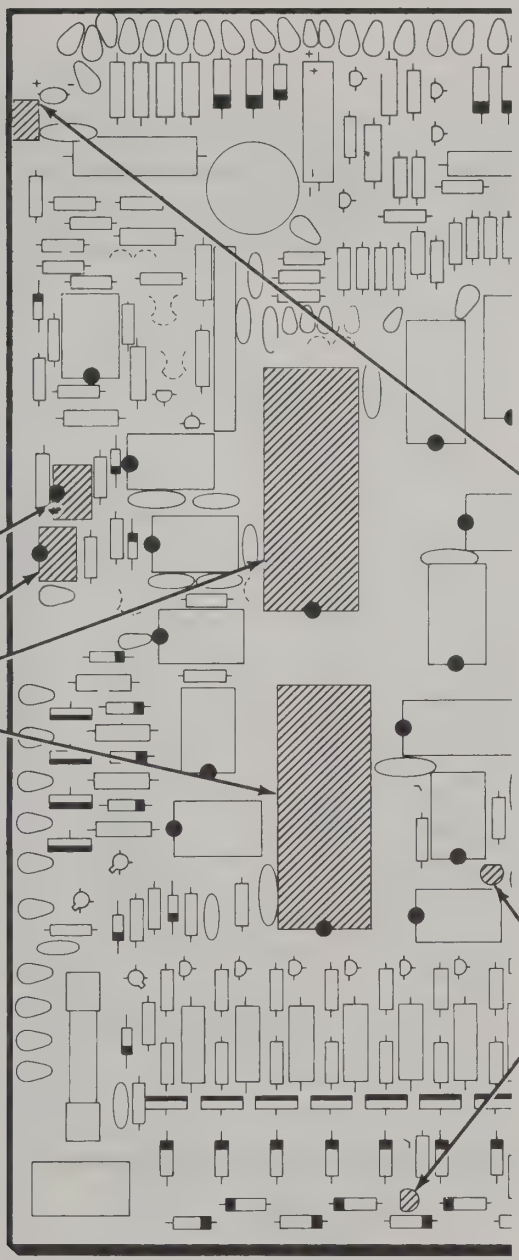
() 6-pin IC socket at U102.

() 6-pin IC socket at U101.

() 40-pin IC socket at U105.

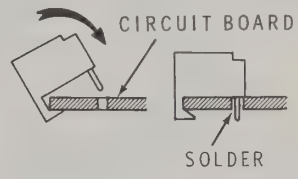
() 40-pin IC socket at U106.

NOTE: Do not install IC's at this time.



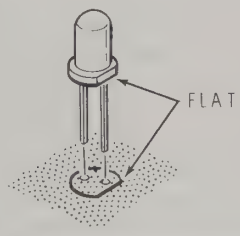
CONTINUE

NOTE: When you install the 3-pin connector in the following step, place the edge mount retainers under the edge of the circuit board and then rotate the connector to insert the solder terminals through the circuit board holes.



() S103: 3-pin connector (#432-921).

IMPORTANT: As you install LED's in the following steps, be sure to match the flat on each LED with the outline of the flat on the circuit board as shown.



() LED102: Push the LED down against the circuit board; then solder the leads to the foil and cut off the excess lead lengths.

() LED101: Push the LED down against the circuit board; then solder the leads to the foil and cut off the excess lead lengths.

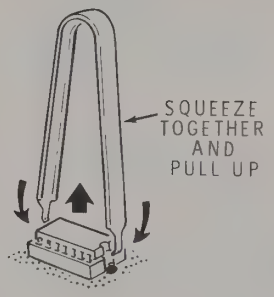
PICTORIAL 1-10

START

NOTES:

1. Refer to Detail 1-11A and, as you install each IC in the following steps, position the pin 1 end (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the IC leads into the socket and push the IC down into place.

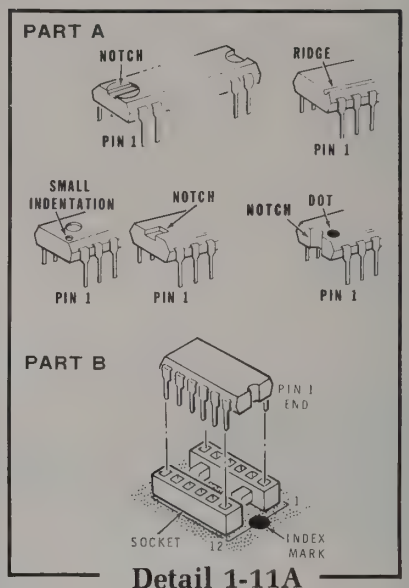
2. If you need to remove an IC from its socket, use the IC puller furnished with your kit, as shown below.



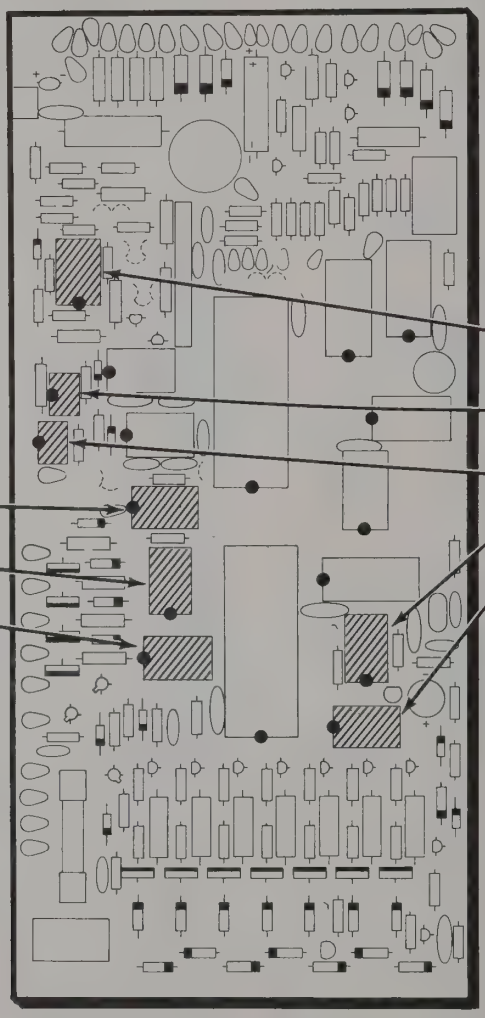
() U107: 7474 IC (#443-6).

() U116: 7416 IC (#443-73).

() U115: 7416 IC (#443-73).



Detail 1-11A



CONTINUE

() U117: 2901 (or 3301) IC (#442-616).

() U102: 4N26 IC (#443-808).

() U101: 4N26 IC (#443-808).

() U108: 74LS00 IC (#443-728).

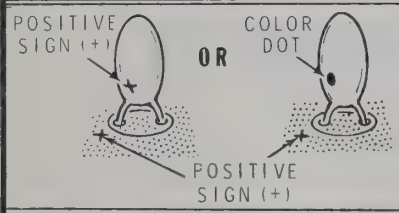
() U114: 7416 IC (#443-73).

NOTE: Do not install any other IC's at this time.

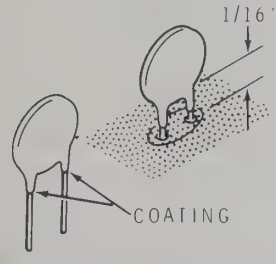
PICTORIAL 1-11

START

() C115: 10 μF (10 M) tantalum. Be sure to install the lead marked with the positive (+) mark or color dot on the capacitor in the positive (+) marked hole on the circuit board.



NOTE: A coating on ceramic capacitor leads next to the capacitor body will sometimes make soldering difficult. When you install one of these capacitors, position it 1/16" off the circuit board. This will prevent the coating from protruding through the circuit board.



() C114: .1 μF ceramic.

() C123: .1 μF ceramic.

() C103: 330 pF ceramic.

() C101: 330 pF ceramic.

() C102: 330 pF ceramic.

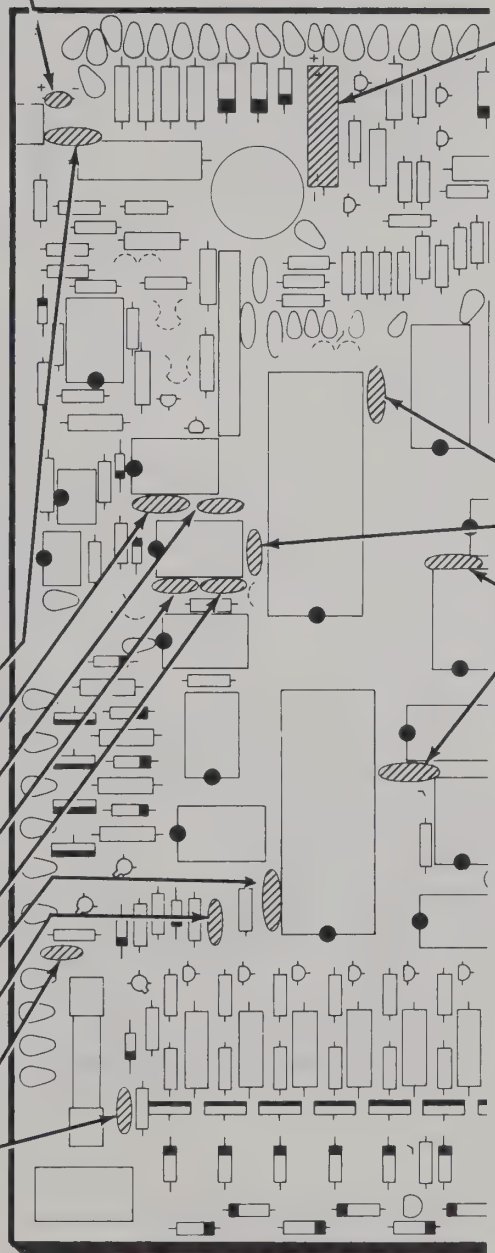
() C116: .1 μF ceramic.

() C112: .05 μF ceramic.

() C109: .05 μF ceramic.

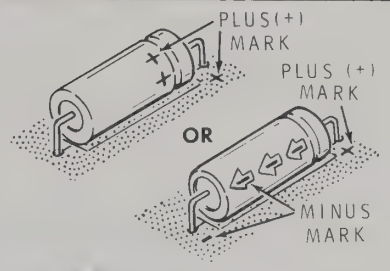
() C111: .05 μF ceramic.

() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

() C113: 220 μF electrolytic. The circuit board may be marked "250." Be sure to install the lead marked with the positive (+) mark in the positive (+) marked hole on the circuit board, or install the minus (−) marked lead in the minus marked hole.



() C122: .1 μF ceramic.

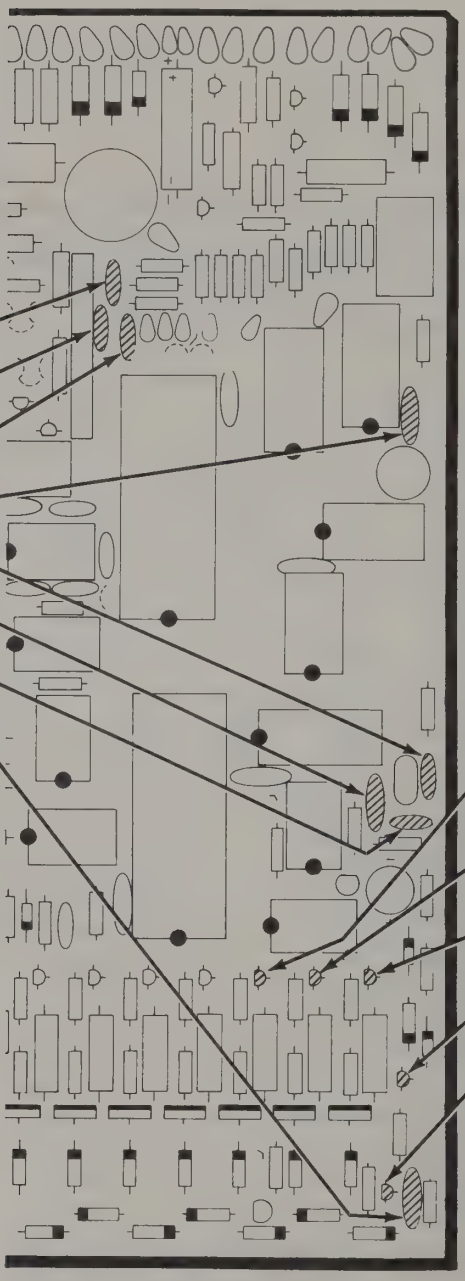
() C104: 330 pF ceramic.

() C119: .1 μF ceramic.

() C117: .1 μF ceramic.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-12



START

() C106: 330 pF ceramic.

() C107: 330 pF ceramic.

() C105: 330 pF ceramic.

() C121: .1 μF ceramic.

(✓) C108: 27 pF ceramic.

() C118: .1 μF ceramic.

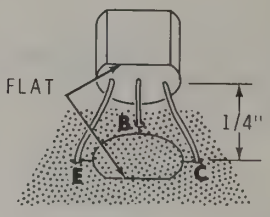
() C110: .002 μF ceramic.

() C124: .1 μF ceramic.

() Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

NOTE: When you install each of the following transistors, first line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct E, B, and C holes. Solder the leads to the foil and cut off the excess lead lengths.



(✓) Q113: MPSA05 transistor (#417-864).

() Q109: MPSA05 transistor (#417-864).

(✓) Q103: MPSA05 transistor (#417-864).

(✓) Q128: MPS-A20 (#417-801).

(✓) Q129: MPSA55 transistor (#417-865).

PICTORIAL 1-13

START

NOTE: In the following steps, be careful not to intermix the #417-865 and #417-864 transistors.

() Q125: MPSA55 transistor (#417-865).

() Q126: MPSA05 transistor (#417-864).

() Q127: MPSA05 transistor (#417-864).

() Q124: MPSA55 transistor (#417-865).

() Q101: MPSA55 transistor (#417-865).

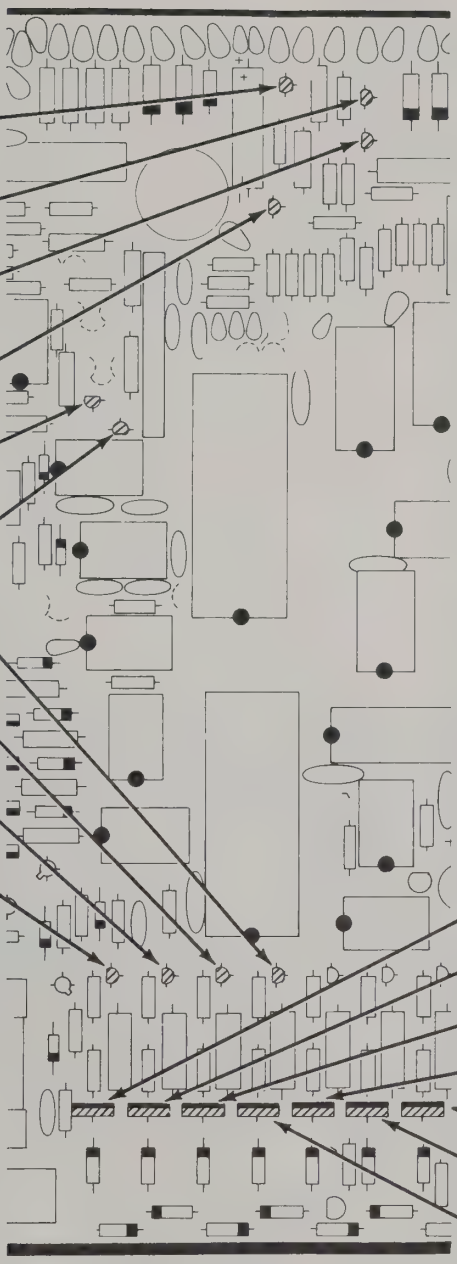
() Q102: Selected transistor (#417-897).

() Q105: MPSA05 transistor (#417-864).

() Q111: MPSA05 transistor (#417-864).

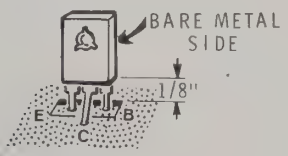
() Q107: MPSA05 transistor (#417-864).

() Q115: MPSA05 transistor (#417-864).



CONTINUE

Install seven SJE607 transistors (#417-263). Solder each transistor as it is installed and cut off the excess lead lengths.



() Q116.

() Q108.

() Q112.

() Q114.

() Q104.

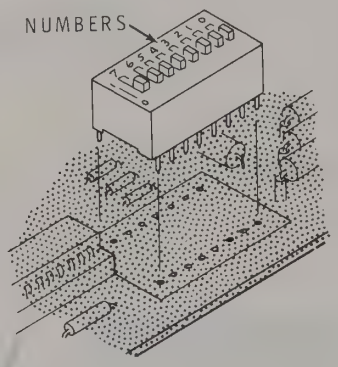
() Q110.

() Q106.

PICTORIAL 1-14

START

NOTE: In the next step be sure to position the switch assembly with the numbers as shown. (It may have slide or rocker switches.)

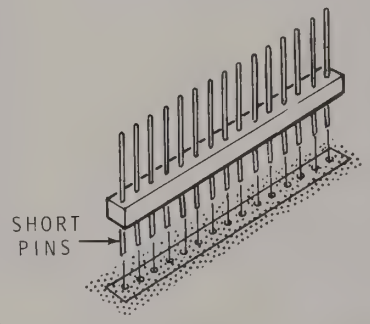


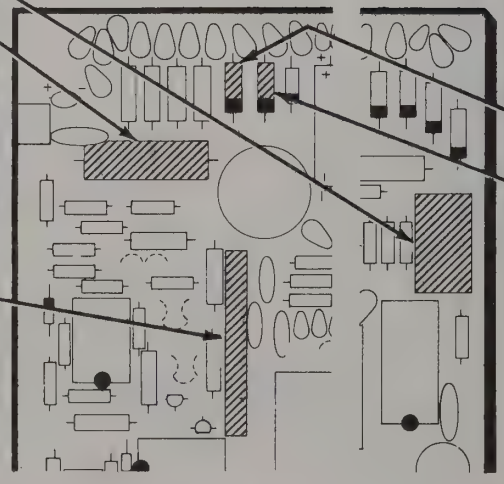
() SW102: Switch assembly (#60-621).

() R189: 390 Ω, 5-watt, 5%. Position this resistor 1/8" above the circuit board.

() Solder the leads to the foil and cut off the excess lead lengths.

() S102: 15-pin connector (#432-1039). Make sure you solder the **short** pins to the circuit board.

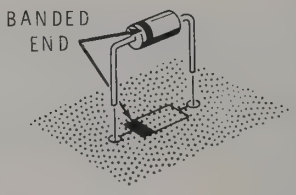




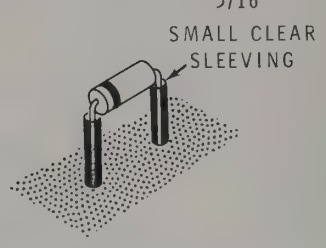
PICTORIAL 1-15

CONTINUE

NOTE: When you install the following diodes, be sure to position the banded end of each diode as it is shown on the circuit board.



() Cut four 5/16" pieces of small clear sleeving. Place one piece on each diode lead in the following two steps to space the diodes above the circuit board.

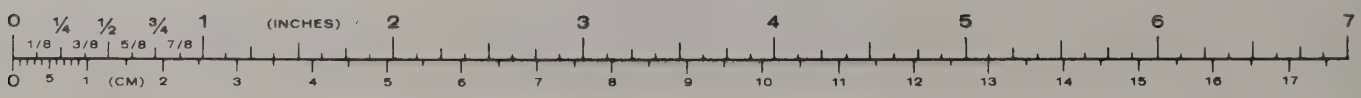


() D125: 3A1 diode (#57-42).

() D123: 3A1 diode (#57-42).

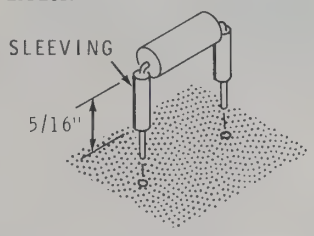
() Solder the leads to the foil and cut off the excess lead lengths.

Refer to Modification Instructions and perform steps in PART II



START

() Cut eight 5/16" pieces of small clear sleeving. Place the sleeving over the leads of the next four diodes.



() D122: 3A1 diode (#57-42).

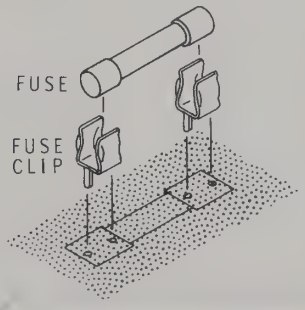
() D118: 3A1 diode (#57-42).

() D121: 3A1 diode (#57-42).

() D119: 3A1 diode (#57-42).

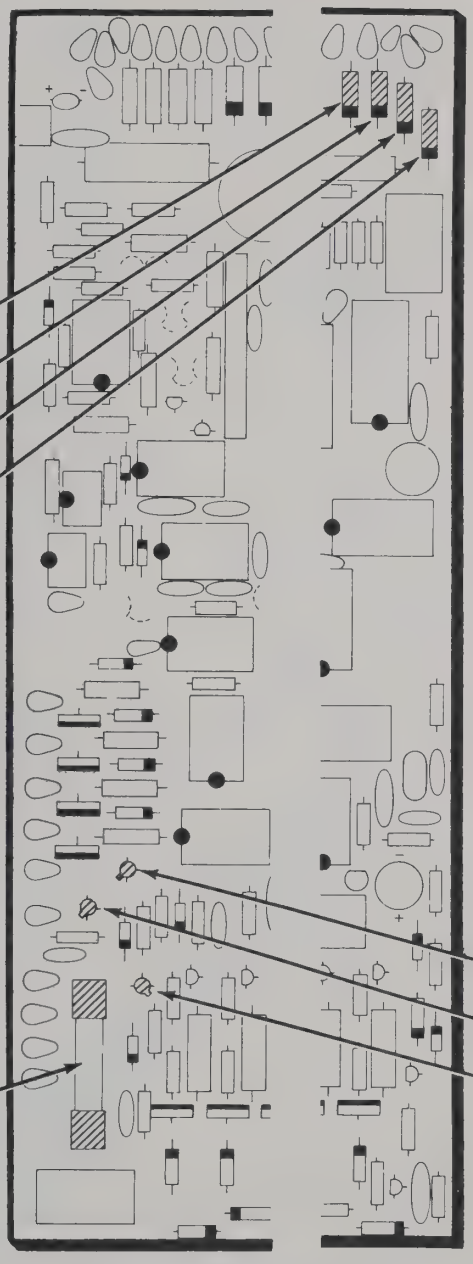
() Solder the leads to the foil and cut off the excess lead lengths.

() Install a fuse clip (#260-65) on each end of the 6/10-ampere slow-blow fuse (#421-63) as shown.



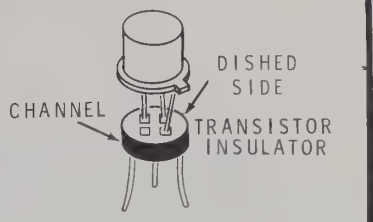
() F101: Install the fuse clips and fuse at the area marked .6 AMP.

() Solder the fuse clips to the foil. NOTE: Do not use excessive heat. Excessive heat will damage the fuse.

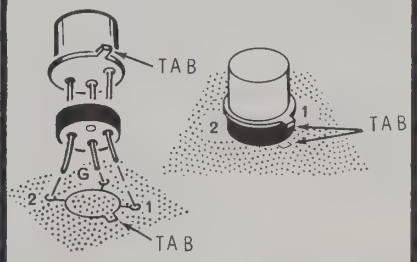


CONTINUE

() Install transistor insulators (#75-159) on three T2302F (H103SG) triacs (#57-612). Make sure the transistor insulator is installed as shown below:



NOTE: When you install each of the following three transistors, line up the tab on the transistor with the outline of the tab on the circuit board. Then install the leads in their correct 2, G, and 1 holes. Push the transistor down until the insulator touches the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

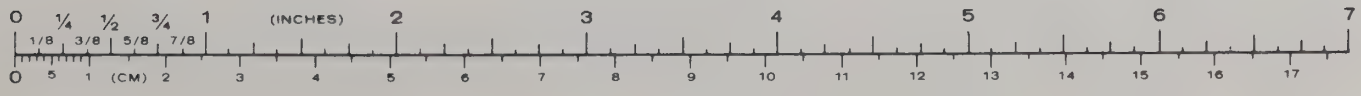


() Q119: T2302F triac (#57-612).

() Q117: T2302F triac (#57-612).

() Q118: T2302F triac (#57-612).

PICTORIAL 1-16



START

() Y101: 4 MHz crystal (#404-536).

() Solder the leads to the foil and cut off the excess lead lengths.

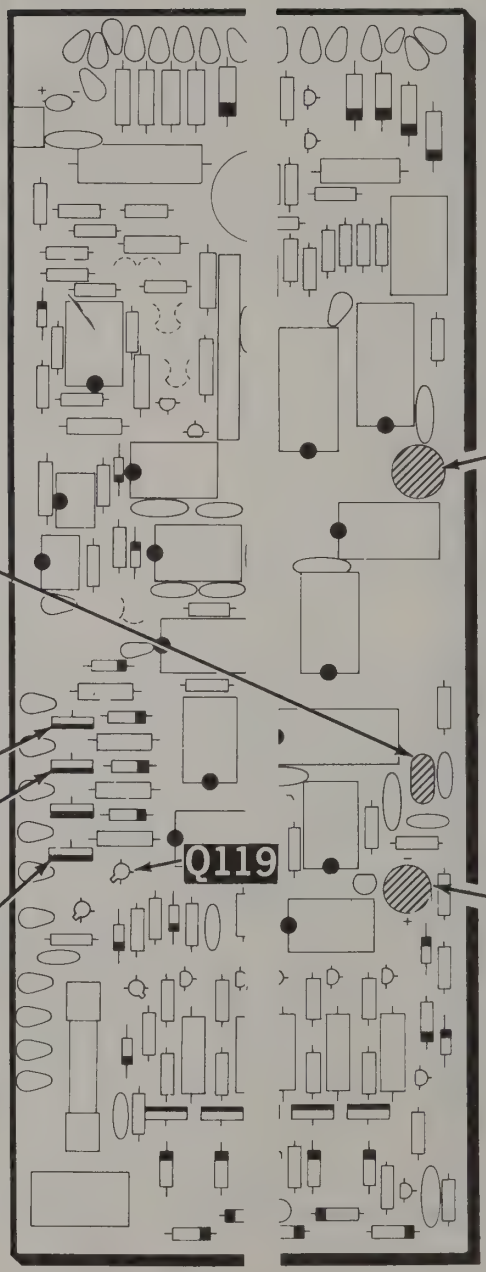
Do not install parts at the following locations.

() Q121

() Q120

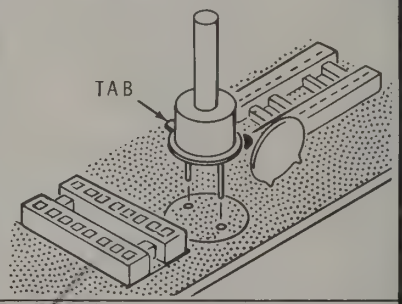
() Q123

() Q122



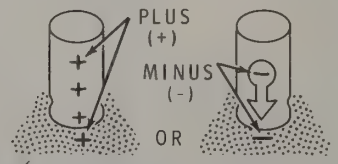
CONTINUE

NOTE: In the next step, be sure to position the pushbutton switch as shown.



() SW101: Pushbutton switch (#64-838).

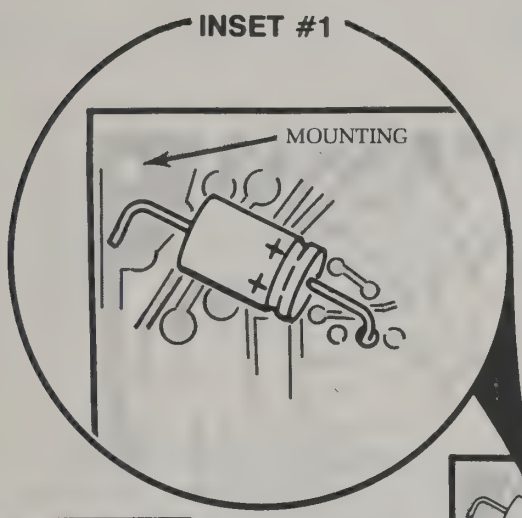
NOTE: When you install electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board OR match the minus (−) mark on the capacitor with the minus (−) mark on the circuit board.

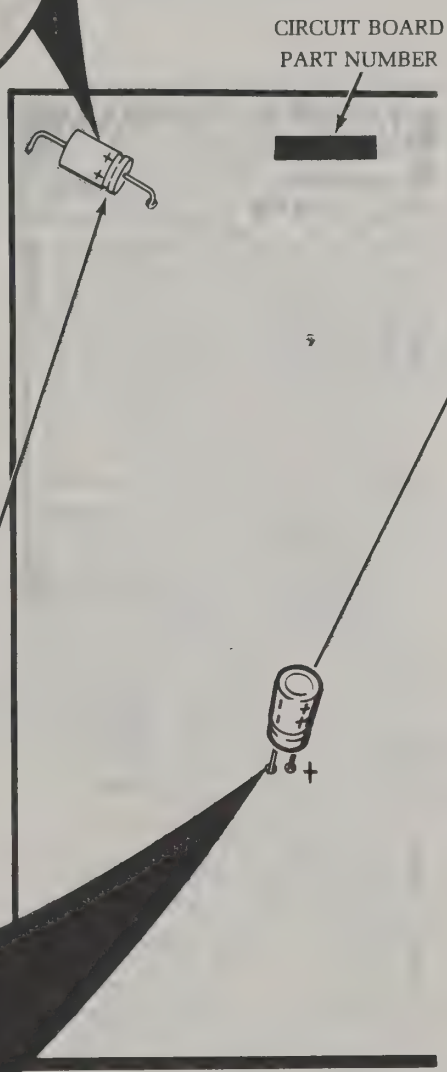


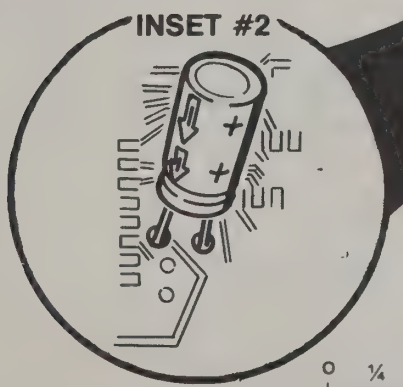
() C25: 500 µF electrolytic.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-17







START

() Turn the circuit board component side down and position it as shown. The parts in the following steps will be installed on this side of the board.

NOTE: No circuit board holes are provided for the following parts. Solder the leads directly to the foil.

() Cut both leads of a 250 μF electrolytic capacitor to 1/2".

() C126: Refer to inset drawing #1 and solder the positive (+) lead of the capacitor to the indicated foil.

() Solder the negative (−) lead to the ground foil as shown. Make sure the capacitor does not obstruct the circuit board mounting hole.

() Cut off any excess lead lengths, and make sure the leads do not touch any other foils.

PICTORIAL 1-18



CONTINUE

() Cut the leads of a 39 μF electrolytic capacitor to 3/8".

() C127: Refer to inset drawing #2 and solder the positive (+) lead of the capacitor to the indicated foil. Then solder the negative (−) lead to the indicated foil.

() Cut off any excess lead lengths; make sure the leads do not touch any other foils. Then push the capacitor down flat against the circuit board.

Carefully inspect the circuit board for the following conditions.

() Unsoldered connections.

() Poor solder connections.

() Solder bridges between foils.

() Protruding leads which could touch together.

() Transistors for the proper type and installation.

() Electrolytic and tantalum capacitors for the correct position of the positive (+) end.

() Diodes for the correct position of the banded end.

NOTE: The 200 Ω control will be installed later.

Set the main circuit board aside temporarily and proceed to "Stepper Driver Circuit Board."

STEPPER DRIVER CIRCUIT BOARD

PARTS LIST

Unpack the following parts from the Pack #2 and check each part against the following list. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

The key numbers correspond to the numbers on the "Parts Pictorials" in the separate "Illustration Booklet."

To order a replacement part: Always include the PART NUMBER. Use the Parts Order Form furnished with the kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover. For prices, refer to the separate "Heath Parts Price List."

RESISTORS

NOTE: All resistors have a 5% tolerance (gold fourth band).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-121-12	2	120 Ω, 1/4-watt (brown-red-brown)	R203, R205
A1	6-122-12	6	1200 Ω, 1/4-watt (brown-red-red)	R201, R202, R204, R206, R213, R215
A1	6-473-12	1	47 kΩ, 1/4-watt (yellow-violet-orange)	R207
A2	6-471	4	470 Ω, 1/2-watt (yellow-violet-brown)	R208, R209, R211, R212
A3	3-41-10	2	33 Ω, 10-watt, wire-wound	R216, R217
A4	3-26-5	1	390 Ω, 5-watt, wire-wound	R214

CAPACITORS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	21-46	2	.005 μF ceramic	C201, C202
B1	21-199	1	.1 μF ceramic	C203
B2	27-62	1	.68 μF Mylar*	C204

DIODES — TRANSISTORS — INTEGRATED CIRCUITS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	57-65	5	1N4002 diode	D201, D202, D203, D204, D205
C2	417-263	1	SJE607 transistor	Q205
C3	417-852	4	TIP31 transistor	Q201, Q202, Q203, Q204
C4	417-864	1	MPS-A05 transistor	Q206
C5	443-23	1	74122 integrated circuit	U202
C5	443-73	1	7416N integrated circuit	U203
C5	443-698	1	7486N integrated circuit	U201

IC SOCKET

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
D1	434-298	3	14-pin IC socket

* DuPont registered trademark

HEATHKIT®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

PARTS FROM FINAL PACK

	344-50	6″	Large black solid wire
	344-52	6″	Large red solid wire
	344-53	6″	Large orange solid wire
	344-54	6″	Large yellow solid wire
	344-55	6″	Large green solid wire
	344-58	6″	Large gray solid wire
	344-74	6″	Large white-yellow solid wire

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

Parts From Final Pack (cont'd.)

	344-78	6″	Large white-gray solid wire
	344-163	24″	Small black solid wire
	85-2355-1	1	Stepper driver circuit board

STEP-BY-STEP ASSEMBLY

START

Position the circuit board as shown in the Pictorial. Then perform the following steps.

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. THE CIRCUIT WILL NOT WORK IF A DIODE IS INSTALLED BACKWARDS. See Detail 1A at the bottom of this column.

If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass.

() D205: 1N4002 diode (#57-65).

() R205: 120 Ω (brown-red-brown).

NOTE: Use the small black wire to make jumper wires in the following steps. Cut each wire to the indicated length and remove 1/4" of insulation from each end.

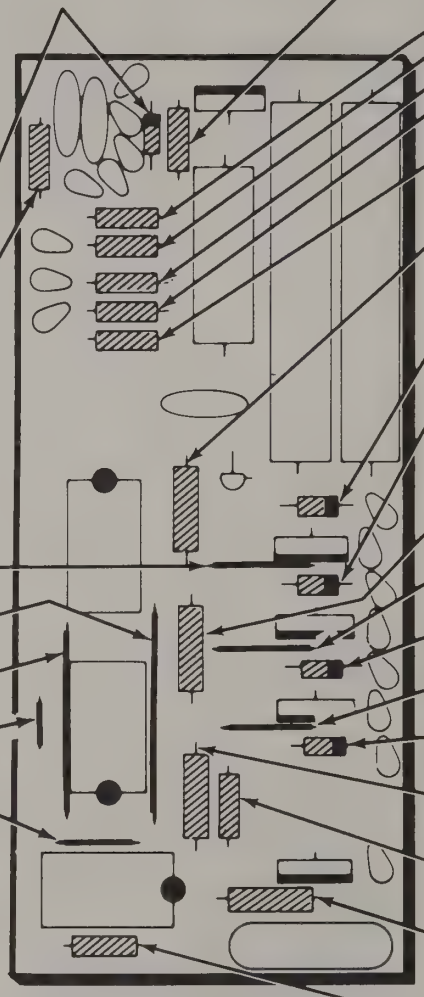
() 1" jumper wire.

() 1-3/4" jumper wire.

() 1-1/2" jumper wire.

() 3/4" jumper wire.

() 1" jumper wire.



PICTORIAL 2-1

CONTINUE

() R215: 1200 Ω (brown-red-red).

Install four 1200 Ω (brown-red-red) resistors at:

() R201.
() R206.
() R204.
() R202.

() R203: 120 Ω (brown-red-brown).

() R209: 470 Ω, 1/2-watt (yellow-violet-brown).

() D202: 1N4002 diode (#57-65).

() D203: 1N4002 diode (#57-65).

() Solder the leads to the foil and cut off the excess lead lengths.

() R211: 470 Ω, 1/2-watt (yellow-violet-brown).

() 1" jumper wire.

() D201: 1N4002 diode (#57-65).

() 1" jumper wire.

() D204: 1N4002 diode (#57-65).

() R208: 470 Ω, 1/2-watt (yellow-violet-brown).

() R213: 1200 Ω (brown-red-red).

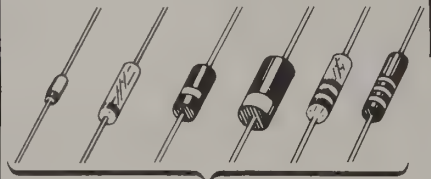
() R212: 470 Ω, 1/2-watt (yellow-violet-brown).

() R207: 47 kΩ (yellow-violet-orange).

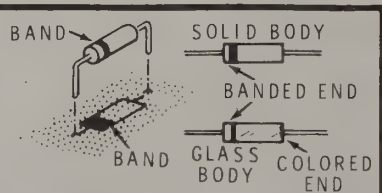
() Solder the leads to the foil and cut off the excess lead lengths.

Detail 2-1A

NOTE DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



BANDED END



START

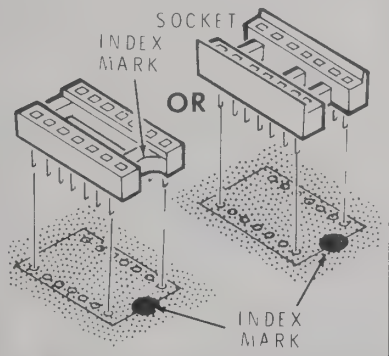
() C202: .005 μF ceramic.

() C203: .1 μF ceramic.

() C201: .005 μF ceramic.

() Solder the leads to the foil and cut off the excess lead lengths.

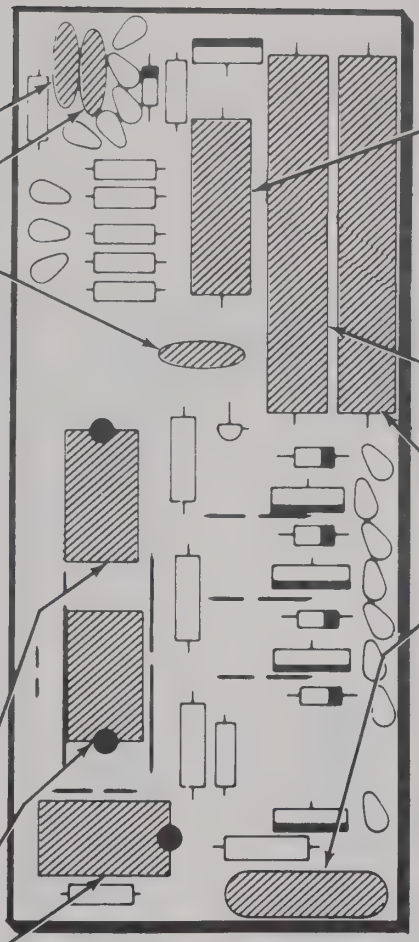
As you install the IC sockets in the following steps: make sure the leads are straight, insert the leads into the holes and then solder the leads to the foil.



() 14-pin IC socket at U201.

() 14-pin IC socket at U203.

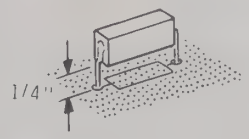
() 14-pin IC socket at U202.



PICTORIAL 2-2

CONTINUE

() R214: 390 Ω, 5-watt. Mount this resistor 1/4" above the circuit board as shown.

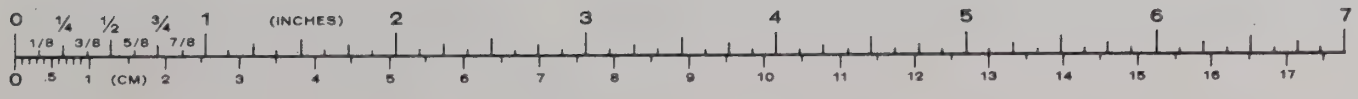


() R217: 33 Ω, 10-watt. Mount this resistor 1/4" above the circuit board.

() R216: 33 Ω, 10-watt. Mount this resistor 1/4" above the circuit board.

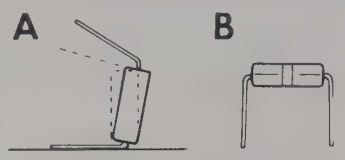
() C204: .68 μF Mylar.

() Solder the leads to the foil and cut off the excess lead lengths.

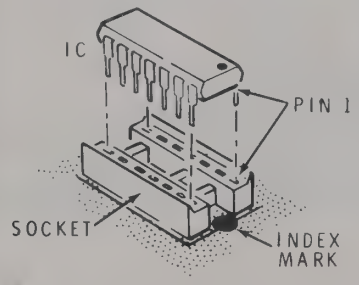


START

Before you install an IC, first be sure the pins are straight. Then lay it down on one of its rows of pins, as shown at A below and roll the IC over until the pins are at right angles or are bent in slightly as shown at B. Repeat this process for the other row of pins.



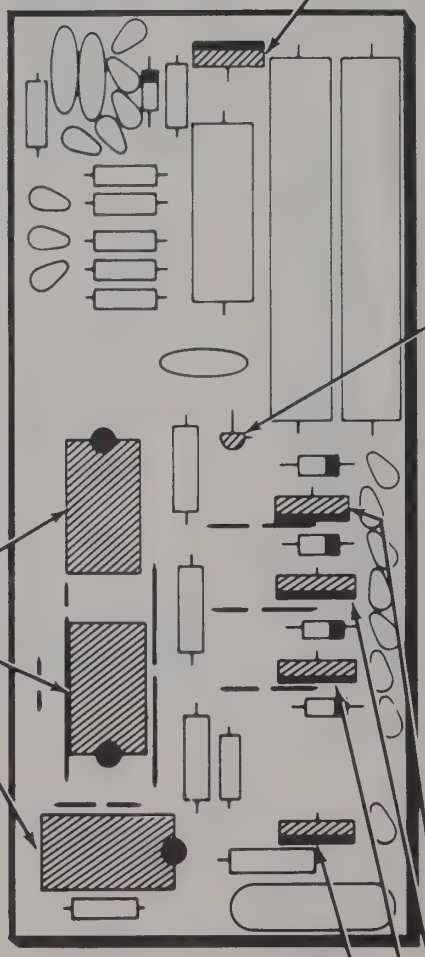
NOTE: To install an integrated circuit (IC), be sure the leads are straight. Refer to Detail 3A (at the bottom of this page) and identify the pin 1 end of the integrated circuit. Then position the pin 1 end toward the index mark on the circuit board and carefully install the integrated circuit. Make sure all the pins are in their respective holes.



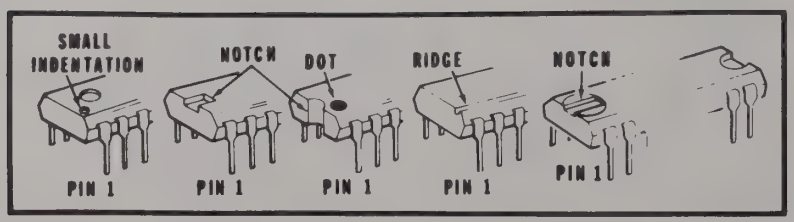
() U201: 7486N IC (#443-698).

() U203: 7416N IC (#443-73).

() U202: 74122 IC (#443-23).



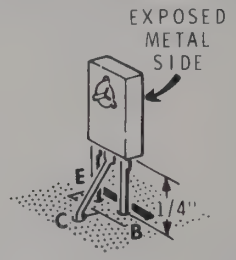
PICTORIAL 2-3



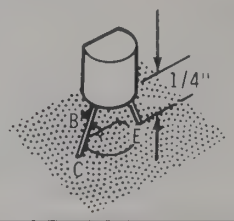
CONTINUE

Solder the leads to the foil and cut off the excess lead lengths as you install each part in the following steps.

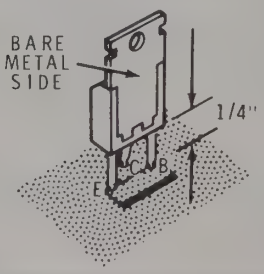
(V) Q205: SJE607 transistor (#417-263). Position the bare metal side of the transistor toward the heavy black line on the circuit board. Then insert the leads into the proper holes as shown.



(V) Q206: MPSA05 transistor (#417-864). Line up the flat on the transistor with the outline of the flat on the circuit board. Then insert the leads into the proper holes as shown.



When you install each of the following transistors, position the bare metal side toward the heavy black line on the circuit board. Then insert the leads into the proper holes as shown.



(V) Q202: TIP31 transistor (#417-852).

(V) Q203: TIP31 transistor (#417-852).

(V) Q201: TIP31 transistor (#417-852).

(V) Q204: TIP31 transistor (#417-852).

START

() Remove 1/4" of insulation from each end of the eight 6" wires. NOTE: Discard any leftover **small** black wire; it will not be used.

Connect one end of each wire to the circuit board in the following steps. Solder each wire to the foil and cut off any excess wire lengths.

() Black to hole E

() Red to hole G

() Orange to hole F

() Green to hole AE

() Yellow to hole A

() Gray to hole D

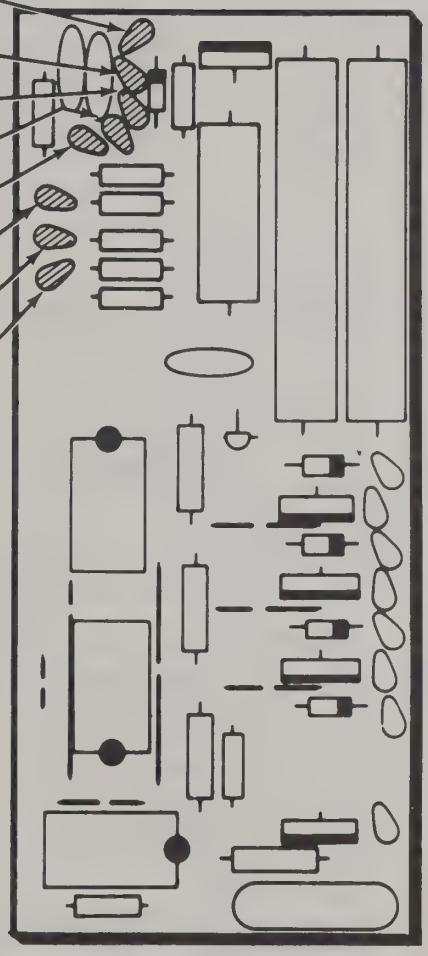
() White-gray to hole C

() White-yellow to hole B

() Check the circuit board over carefully to make sure all connections are properly soldered. Also check for solder bridges, especially around IC sockets.

Set the circuit board aside temporarily.

FINISH



PICTORIAL 2-4

CHASSIS

PARTS LIST

Unpack the final pack and check each part against the following list. The key numbers correspond to the numbers on the Chassis Parts Pictorial (in the Illustration Booklet, Pages 3 through 5). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after it is identified until it is called for in a step.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For prices, refer to the separate "Heath Parts Price List."

ELECTRICAL PARTS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	21-70	1	.01 μF ceramic capacitor	C1
A2	25-836	1	17 μF electrolytic capacitor	C5
A3	25-208	1	1500 μF electrolytic capacitor	C4
A3	25-272	1	6000 μF electrolytic capacitor	C2
A4	25-854	1	5600 μF electrolytic capacitor	C3
A5	150-74	1	OPB 813, SPX 1874-1, or or EOS-2A1 optical switch	Q3
A6	412-616	2	FLV177 LED (red)	LED1, LED2
A7	412-635	1	TIL-32 (clear)	LED3
A7	417-919	1	TIL-78 transistor (clear)	Q2
A8	417-892	1	MJ2941 transistor	Q1
A9	442-54	1	UA7805 integrated circuit	U1
A10	421-20	1	3AG, 1/2-ampere, slow-blow fuse	F1
A10	421-23	1	3AG, 1-ampere, slow-blow fuse	F1
A11	423-11	1	Fuseholder	
A12	266-996	1	Print head	
A13	54-962	1	Power transformer	T1

MOTORS

B1	420-94	1	Head motor	
B2	420-603	1	Paper drive motor	
B3	420-602	1	Ribbon motor	

SWITCHES

C1	60-54	1	Slide switch, 120/240	SW2
C2	60-608	1	Slide switch, NOR/LOW	SW3
C3	64-860	1	Switch assembly	

INSULATORS

D1	75-88	1	Insulator case	
D2	75-140	1	Transistor insulator	
D3	75-715	1	Insulating paper 1-1/2" × 1-7/8"	
D4	75-741	1	Insulating paper, 2-1/2" × 4-1/8"	
D5	75-775	1	Insulating paper, 4-3/8" × 5"	

TERMINAL STRIPS — CONNECTORS

E1	431-3	1	Large 3-lug terminal strip	
E2	431-15	2	1-lug terminal strip	
E3	431-16	1	Small 2-lug terminal strip	
E4	431-41	1	Large 2-lug terminal strip	
E5	431-604	1	3-lug terminal strip	
E6	432-866	4	Connector pin	
E7	432-1030	2	Connector shell	

HEATHKIT®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

SPACERS — SPRINGS

F1	255-29	2	7/32" spacer
F2	255-74	2	1/16" spacer
F3	255-78	4	5/8" spacer
F4	255-790	2	1-1/4" hex spacer
F5	255-742	9	9/64" spacer
F6	255-743	3	Brass spacer
F7	255-725	1	3/32" shoulder spacer
F8	258-4	2	Ribbon guide spring
F9	258-103	2	Paper hold-down spring
F10	258-719	1	Pawl spring
F11	258-720	2	Ribbon tension spring
F12	258-724	1	Pulley spring

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, or HDW #2 and #6, etc). You may have to open more than one packet to locate all the hardware of any one size (#6, for example).

#2 Hardware

F13	250-1172	2	2-56 × 1/4" screw

#4 Hardware

G1	250-52	27	4-40 × 1/4" screw
G2	250-156	4	4-40 × 1/8" setscrew
G3	250-273	16	4-40 × 3/8" screw
G4	250-366	2	4-40 × 3/16" screw
G5	250-375	8	4-40 × 5/16" flat head screw
G6	250-1184	2	# 4 × 1/4" self-tapping screw
G7	250-1218	2	#4 × 7/16" self-tapping screw
G8	252-15	15	4-40 nut
G9	252-192	11	4-40 brass insert
G10	253-80	7	#4 flat washer
G11	254-9	22	#4 lockwasher

#6 Hardware

H1	250-48	3	6-32 × 1/2" screw
H2	250-56	15	6-32 × 1/4" screw
H3	250-89	8	6-32 × 3/8" screw
H4	250-116	13	6-32 × 1/4" black screw
H5	250-206	2	6-32 × 11/16" screw
H6	250-13	4	6-32 × 1" screw
H7	250-434	3	6-32 × 3/8" flat head screw
H8	250-1275	1	#6 × 5/8" black self-tapping screw
H9	252-3	10	6-32 nut

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

#6 Hardware (cont'd.)

H10	253-27	14	#6 thick flat washer
H11	253-60	13	#6 thin flat washer
H12	253-89	4	#6 D-washer
H13	254-1	25	#6 lockwasher
H14	259-1	1	#6 solder lug
H15	250-270	1	6-32 × 3/8" black screw
H16	254-6	3	#6 external tooth lockwasher

#8 Hardware

J1	250-92	4	8-32 × 5/8" screw
J2	250-105	6	8-32 × 1/8" setscrew
J3	250-1281	1	8-32 × 3/8" knurled thumbscrew
J4	252-4	8	8-32 nut
J5	254-2	8	#8 lockwasher

Other Hardware

K1	252-7	2	3/8-32 nut
K2	252-708	2	Push-on nut
K3	253-711	1	1/4" flat washer
K4	253-85	2	Felt washer
K5	253-167	2	Teflon washer
K6	253-51	2	E-washer
K7	253-710	2	Cork washer
K8	254-5	2	3/8" lockwasher
K9	257-1	1	Cord retaining clip
K10	257-11	1	Eyelet
K11	259-5	2	#10 solder lug
K12	259-29	2	Long lug
K13	455-26	2	Threaded bushing
K14	262-4	2	Spring retainer pin

SHAFTS — COLLARS — PULLEYS

L1	453-294	1	11-3/4" × 5/16" diameter upper print head shaft
L2	453-309	1	10-5/8" × 1/8" diameter cable guide shaft
L3	453-296	1	Grooved shaft
L4	453-297	1	12-1/4" × 1/4" diameter support shaft
L5	453-298	2	1-1/4" shaft
L6	453-295	1	Lower print head shaft
L7	455-15	3	Small shaft collar
L8	455-647	1	Medium shaft collar
L9	455-649	1	Large shaft collar
L10	100-1769	2	Nylon pulley
L11	466-59	1	Pulley
L12	466-60	4	Ribbon guide

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

PLASTIC PARTS

M1	266-998	1	Left ratchet
M2	266-997	1	Right ratchet
M3	266-999	1	Pawl
M4	266-1042	1	Left reverse lever
M5	266-1043	1	Right reverse lever
M6	454-27	1	Ribbon motor cam
M7	390-1488	1	Mylar paper guide
M8	266-1003	2	Paper hold-down
M9	266-1041	2	Paper lifter
M10	75-754	1	Strain relief

BRACKETS

N1	204-2341	1	Curved paper guide bracket
N2	204-2342	1	Switch bracket
N3	204-2343	1	Motor mounting bracket
N4	204-2344	1	Left paper drive bracket
N5	204-2345	1	Right paper drive bracket
N6	204-2425	1	Right paper hold-down bracket
N7	204-2424	1	Left paper hold-down bracket
N8	204-2348	1	Platen bracket
N9	204-2349	1	Head drive bracket
N10	204-2402-1	2	Hold-down pivot bracket
N11	204-2364	1	Wide paper guide bracket

PLATES — CHASSIS

P1	201-66	1	Chassis
P2	205-1761-1	1	Bottom plate
P3	205-1762	1	Ribbon actuator plate
P4	205-1763	6	Shaft retainer

GROMMETS — CLAMPS

Q1	73-53	1	Rubber grommet
Q2	73-46	1	Plastic grommet
Q3	260-89	2	LED grommet
Q4	207-3	2	Small cable clamp
Q5	207-19	1	Large cable clamp
Q6	207-607	1	Capacitor mounting clamp

LABELS — NAME PLATE

R1	390-1471	1	Model label
R2	390-1472	1	Set-up instruction label
R3	390-1487	1	Warning label
R4		1	Blue and white model label
R5	391-611	1	Name plate
R6	390-1501	1	Clear plastic guard label

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

CORD — WIRE — SLEEVING

	349-1	42″	Print head string
	349-8	8″	Lanyard cord
	344-2	57″	Large black stranded wire
	344-90	27″	Small black stranded wire
	134-1057	1	Wire harness
	347-55	24″	8-wire ribbon cable
	346-66	3-1/2″	Black sleeving

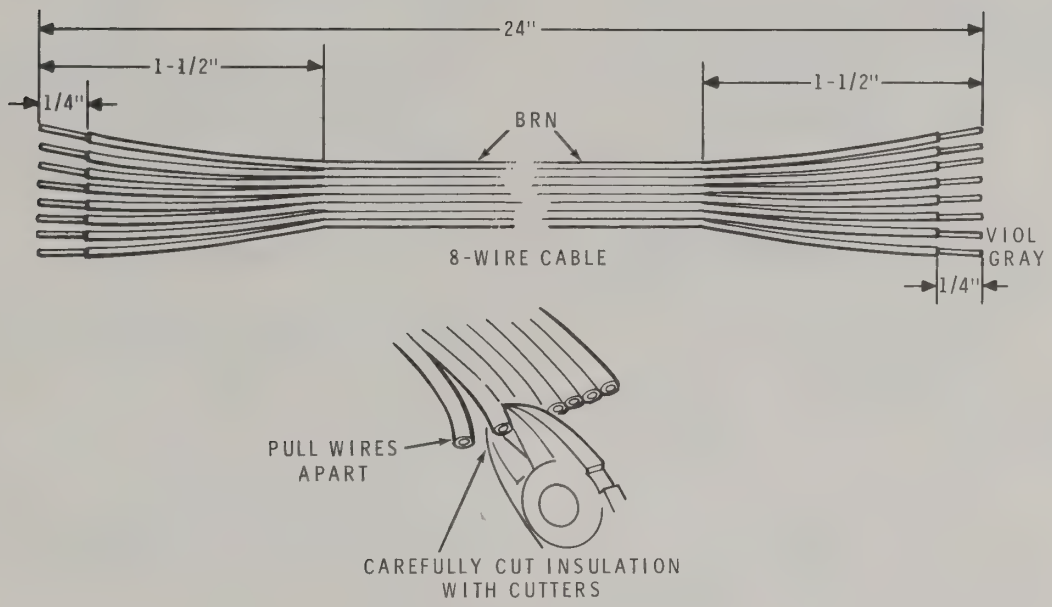
TOOLS

S1	266-1004	1	Feeler gauge
S2	490-5	1	Nut starter
S3	490-6	1	Large allen wrench
S4	490-23	1	Small allen wrench

MISCELLANEOUS

T1	89-54	1	Line cord
T2	95-638	1	Cabinet cover
T3	134-1035	1	Cable assembly
T4	260-90	2	Retainer ring
T5	261-20	4	Mounting foot
T6	265-37	2	Hinge
T7	266-47	2	Gear stop dog
T8	266-1002	1	Paper tray
T9	266-1005	1	Platen
T10	266-1007	1	Ribbon
T11	266-1017	2	Hold-down clip
T12	352-14	1	Grease
T13	352-31	1	Thermal compound (white)
T14	354-6	10	Cable tie
T15	434-336	1	Transistor socket
T16	451-605	1	Spur gear
T17	451-606	2	Sprocket
T18	455-44	2	Snap-in nylon bearing
		1	Paper pack
	595-2173	1	Operation Manual (See Page 1 for part number.)

STEP-BY-STEP ASSEMBLY



Detail 3-1A

SWITCH ASSEMBLY

Refer to Pictorial 3-1 (Illustration Booklet, Page 6) for the following steps.

NOTE: When stranded wire is called for, twist the small wire strands tightly together and then melt a small amount of solder on the bare wire ends to hold the wire strands together.

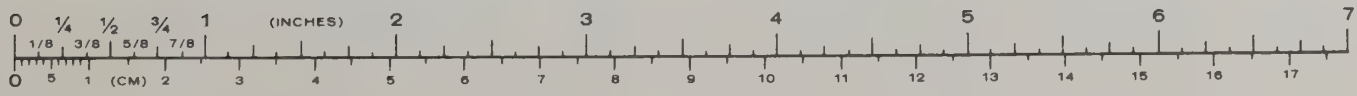
() Refer to Detail 3-1A and prepare both ends of the 8-wire ribbon cable as shown.

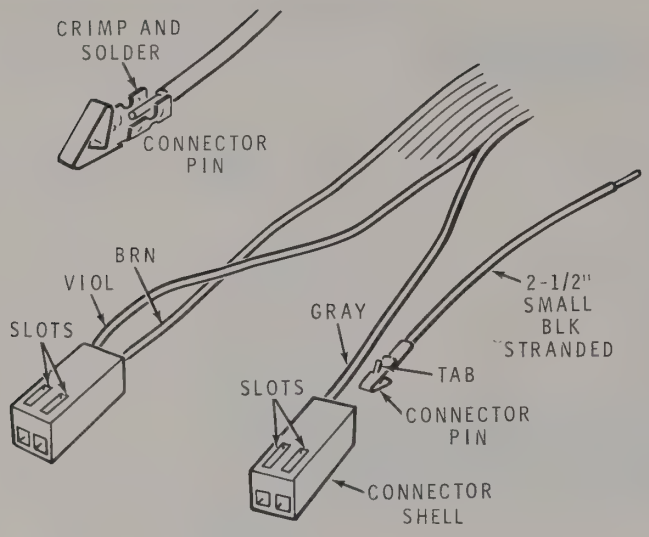
() Temporarily set the cable aside.

NOTE: When wiring this kit, you will be instructed to prepare hookup wires ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. The wires are listed in the order in which they will be used.

() Prepare the following wires:

2-1/2" small black stranded
24" small black stranded
Two 21" large black stranded





Detail 3-1B

Refer to Detail 3-1B for the following seven steps and prepare one end of the 8-wire cable as follows.

1. () Crimp and solder a connector pin to the 2-1/2" small black wire.
2. () Crimp and solder a connector pin to the ribbon cable gray wire.
3. () Crimp and solder a connector pin to the ribbon cable brown wire.
4. () Crimp and solder a connector pin to the ribbon cable violet wire.
5. () At the end of the cable that does not have the connector pins, separate the violet and gray wires from the other wires for an additional 3/4" (total 2-1/4").
6. () Insert the connector pins on the black and gray wires into a connector shell; be sure the connector pins are positioned as shown when you insert the.
7. () Insert the connector pins on the brown and violet wires into a connector shell; be sure the connector pins are positioned as shown when you insert them.

NOTE: In the following steps, (NS) means not to solder the connections because other wires will be added later. (S-) with a number, such as (S-3), means to solder the connection. The number tells how many wires are in the connection.

Refer to Pictorial 3-1 and connect the wires to the open lugs of the switch assembly in the following steps.

() Insert a 2-1/2" bare wire through lugs 2 and 5 SW5, SW8, SW7, and SW6, and through SW4 lug 2 as shown in the Pictorial. Then solder the wire to each lug except the two end lugs (SW4 lug 2 and SW5 lug 2). These lugs will be soldered later.

() 24" small black wire to SW5 lug 2 (S-2).

Position the ribbon cable with the connectors as shown. Then connect the wires in the following steps.

() Orange wire to SW5 lug 4 (S-1).

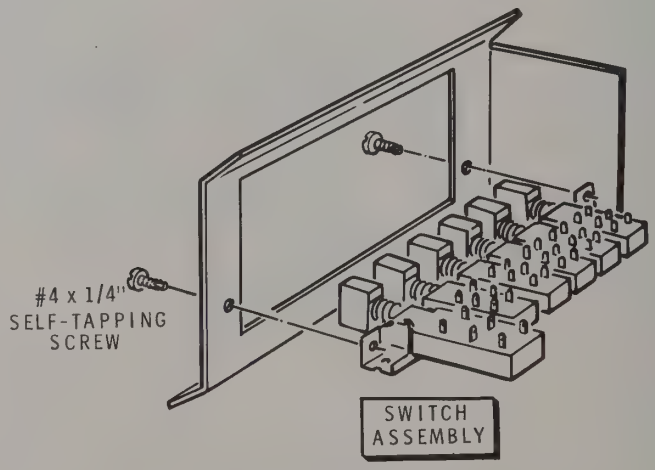
() Blue wire to SW8 lug 4 (S-1).

() Green wire to SW7 lug 4 (S-1).

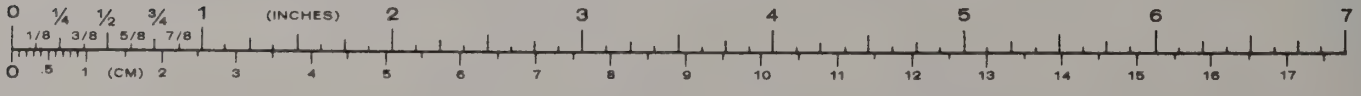
() Yellow wire to SW6 lug 4 (S-1).

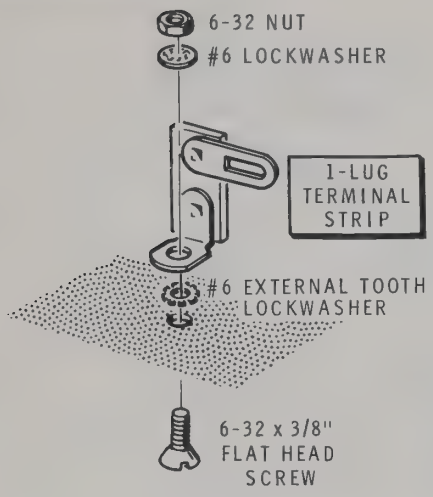
() Red wire to SW4 lug 3 (S-1).

() 2-1/2" black wire coming from the connector to SW4 lug 2 (S-2).



Detail 3-1C





Detail 3-2A

() Either 21" large black wire to SW1 lug 4 (S-1).

() Other 21" large black wire to SW1 lug 5 (S-1).

() Refer to Detail 3-1C and mount the switch assembly to the switch bracket with two #4 × 1/4" self-tapping screws; make sure the wires and ribbon cable are routed as shown in the Pictorial.

Set the switch assembly aside; it will be called for later.

MOTOR MOUNTING BRACKET

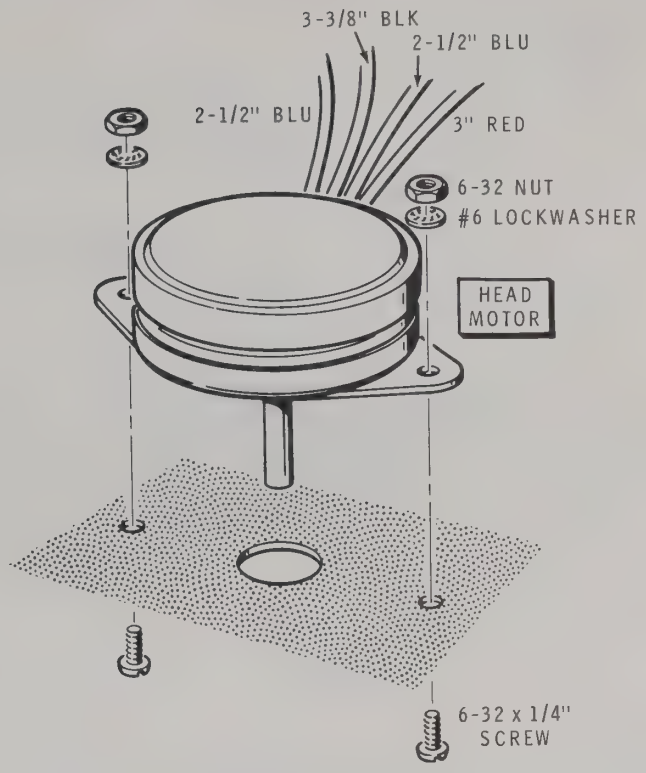
Refer to Pictorial 3-2 (Illustration Booklet, Page 6) for the following steps.

() Position the motor mounting bracket on your work area as shown.

NOTES:

1. In the next four steps, make sure you position the terminal strips as shown in the Pictorial.
2. Use the plastic nut starter supplied with this kit to hold and start 6-32 and 4-40 nuts on screws.
3. Use black screws **only** in steps where they are specifically called for.

() Refer to Detail 3-2A and mount a 1-lug terminal strip at hole AA with a 6-32 × 3/8" flat head screw, a #6 external tooth lockwasher, a #6 lockwasher, and a 6-32 nut.



Detail 3-2B

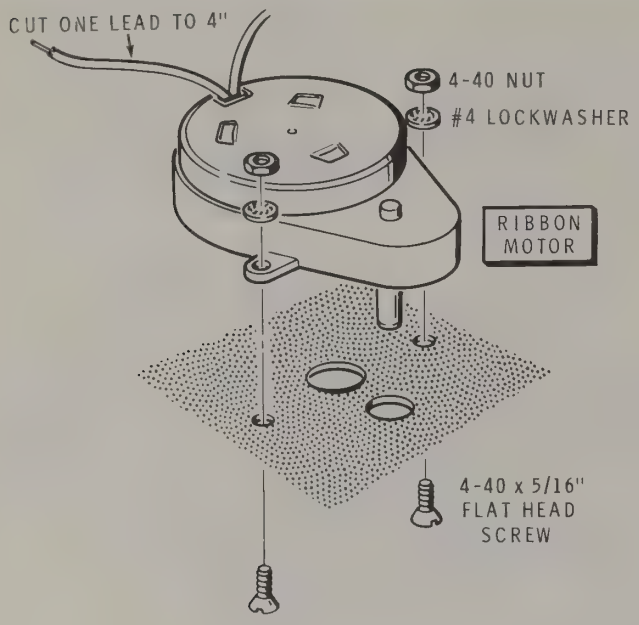
() In a similar manner, mount a small 2-lug terminal strip at hole AB with a 6-32 × 3/8" flat head screw, a #6 external tooth lockwasher, a #6 lockwasher, and a 6-32 nut.

() Mount a large 3-lug terminal strip at hole AC with a 6-32 × 3/8" flat head screw, a #6 external tooth lockwasher, a #6 lockwasher, and a 6-32 nut.

() Mount a 1-lug terminal strip at hole AD with a 6-32 × 1/4" screw, two #6 lockwashers, and a 6-32 nut. (Do not use an external tooth lockwasher here.)

() Locate the head motor (red, blue, and black leads). Then refer to Detail 3-2B and prepare the leads as shown.

() Again refer to Detail 3-2B and mount the head motor at hole AE with two 6-32 × 1/4" screws, #6 lockwashers, and 6-32 nuts.



Detail 3-2C

(V) Refer to Detail 3-2C and prepare the indicated lead of the ribbon motor as shown; then mount the ribbon motor at hole AF with two 4-40 × 5/16" flat head screws, #4 lockwashers, and 4-40 nuts.

Refer to Pictorial 3-3 (Illustration Booklet, Page 6) for the following steps.

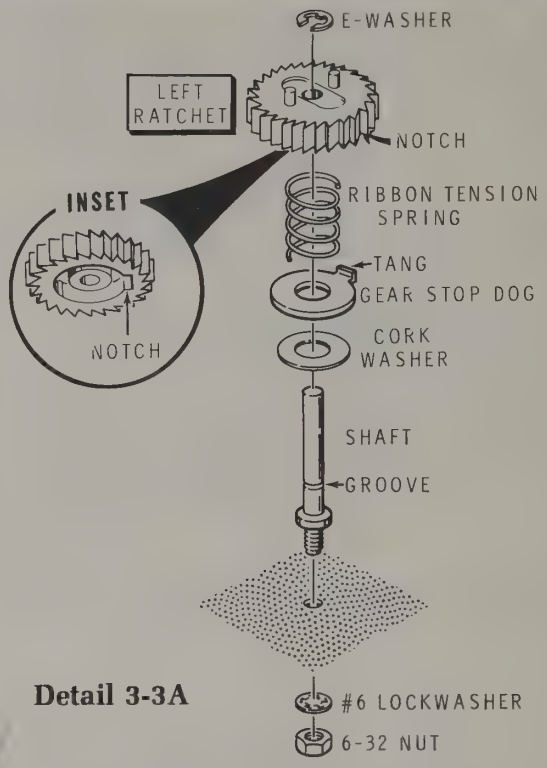
(V) Position the motor mounting bracket on your work area as shown.

Refer to Detail 3-3A for the next five steps. Read the steps through to become familiar with the procedure. Then go back and perform them.

(V) 1. Mount two 1-1/4" shafts at holes AG and AH with a #6 lockwasher, and a 6-32 nut on each shaft.

(V) 2. Place a cork washer, a gear stop dog (position the protruding tang upward), and a ribbon tension spring on each shaft.

() 3. Locate an E-washer and the left ratchet. Make sure you have the left ratchet. Notice the direction of the teeth on the left rachet when the ratchet is positioned as shown in the Pictorial.



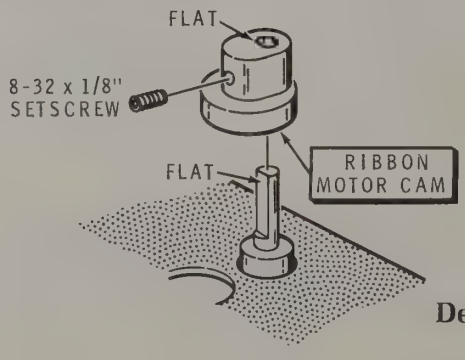
Detail 3-3A

(V) 4. On the shaft at AG, center the spring on the gear stop dog. Then push the ratchet down onto the shaft, making sure the tang fits into the notch on the bottom of the ratchet.

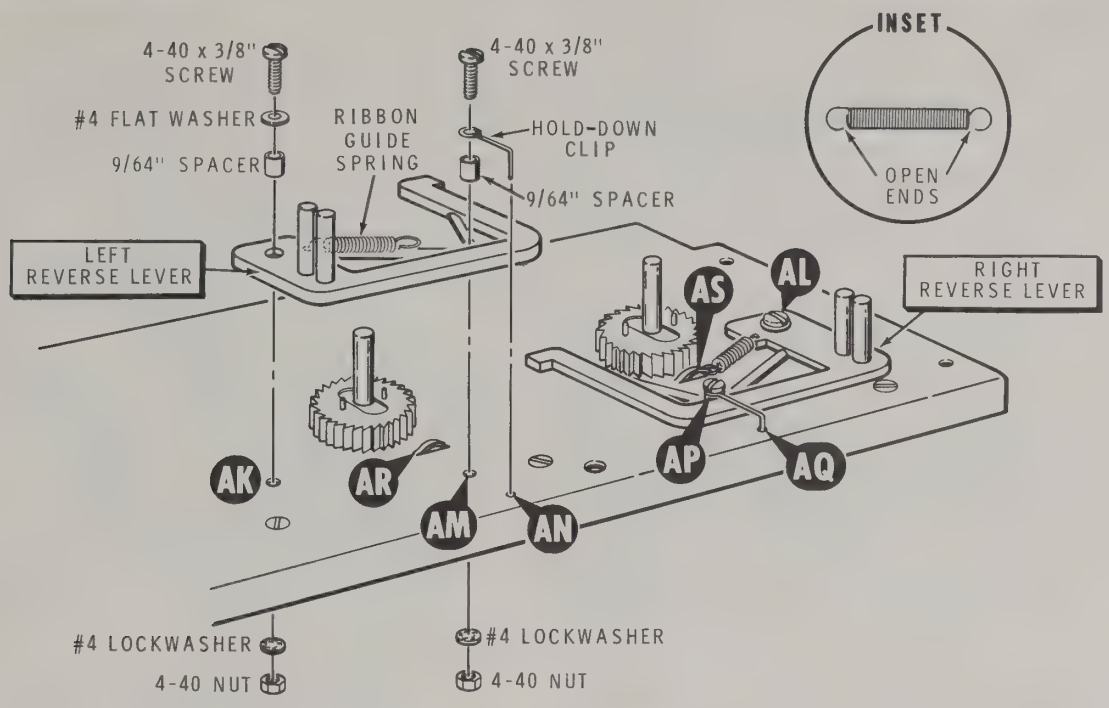
(V) 5. Press the E-washer into the groove on the shaft to hold the ratchet in place.

(V) Using the same procedure, install the right ratchet on the shaft at AH.

(V) Refer to Detail 3-3B and install an 8-32 × 1/8" setscrew in the ribbon motor cam; then slide the cam all the way onto the shaft of the ribbon motor at AJ as shown in the Pictorial. Use the large allen wrench to tighten the setscrew. Do not overtighten the setscrew or the threads may strip.



Detail 3-3B



Detail 3-3C

Refer to Detail 3-3C for the following nine steps.

() 1. Place the left reverse lever with its hole over hole AK on the motor mounting bracket and place a 9/64″ spacer in the hole over hole AK.

() 2. Mount the left reverse lever and spacer at hole AK with a 4-40 × 3/8″ screw, #4 flat washer, #4 lockwasher, and a 4-40 nut.

() 3. Place the right reverse lever with its hole over hole AL on the motor mounting bracket, and place a 9/64″ spacer in the hole over hole AL.

() 4. Mount the right reverse lever and spacer at hole AL with a 4-40 × 3/8″ screw, #4 flat washer, #4 lockwasher, and a 4-40 nut.

() 5. Mount a hold-down clip at hole AM with a 9/64″ spacer, 4-40 × 3/8″ screw, a #4 lockwasher, and a 4-40 nut. Insert the end of the clip in hole AN.

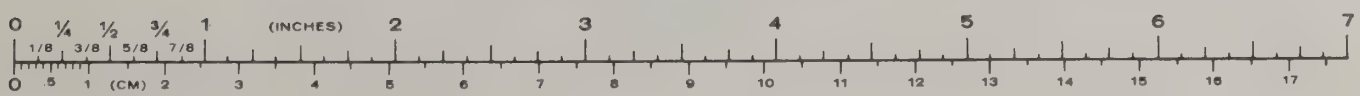
() 6. Mount the other hold-down clip at hole AP with a 9/64″ spacer, 4-40 × 3/8″ screw, #4 lockwasher, and a 4-40 nut. Insert the end of the clip in hole AQ.

() 7. Refer to the inset drawing and open the ends of the ribbon guide springs slightly. NOTE: The ribbon guide springs are longer than the other springs.

() 8. Hook one end of a ribbon guide spring to the chassis lug at AR and the other end of the spring through the hole in the left reverse lever.

() 9. Hook one end of the other ribbon guide spring to the chassis lug at AS and the other end of the spring through the hole in the right reverse lever.

NOTE: The reverse levers should move freely without binding. If necessary, bend the hold-down clip slightly.



Refer to Detail 3-3D for the following five steps.

() 1. Position the ribbon actuator plate on your work area with the stud facing up.

() 2. Place the pawl, plain side down, on the ribbon actuator plate. Align the large hole in the pawl with hole AT.

() 3. Place a 9/64" spacer in the hole in the pawl and mount the pawl and spacer with a 4-40 × 3/8" screw, and #4 flat washer.

() 4. Insert the straight end of the pawl spring in the small hole in the pawl and move the spring downwards until the end of the spring is positioned as shown.

() 5. Hook the loop end of the pawl spring under the head of the stud.

Refer to Detail 3-3E for the following three steps.

() 1. Place three brass spacers with their shoulders up on the motor mounting bracket at holes AU, AV, and AW.

() 2. Place the assembled ribbon actuator plate with the oblong hole over the ribbon motor cam on the three brass spacers. The pawl will engage one of the ratchets.

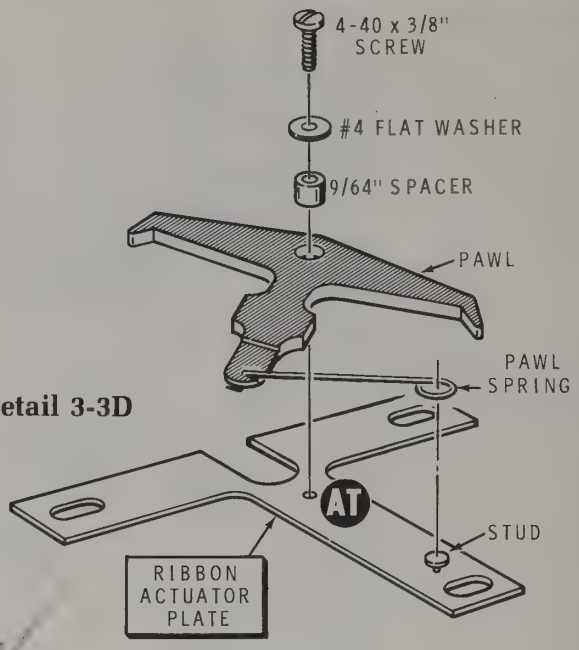
() 3. Mount the ribbon actuator plate and brass spacers at holes AU, AV, and AW with three 6-32 × 1/2" round head screws, and #6 thin flat washers as shown. Do not overtighten the screws.

Refer to Detail 3-3F for the following ten steps.

() 1. Refer to the inset drawing and open the container of grease. Make sure you use the correct grease. The part number (352-14) is stamped on the bottom of the container.

() 2. Apply a thin layer of grease to the motor shaft and both sides of both teflon washers. (Save the remaining grease for use later.)

() 3. Install two 4-40 × 1/8" setscrews in the large shaft collar and in the medium shaft collar; do not install the setscrews all the way into the shaft collars.



Detail 3-3D

() 4. Install the medium shaft collar all the way down on the head motor shaft at AX in Pictorial 3-3 and tighten the setscrews.

() 5. Install a Teflon washer and the 1/4" flat washer with hole (or notch) on the shaft collar.

() 6. Place the pulley spring on the head motor shaft.

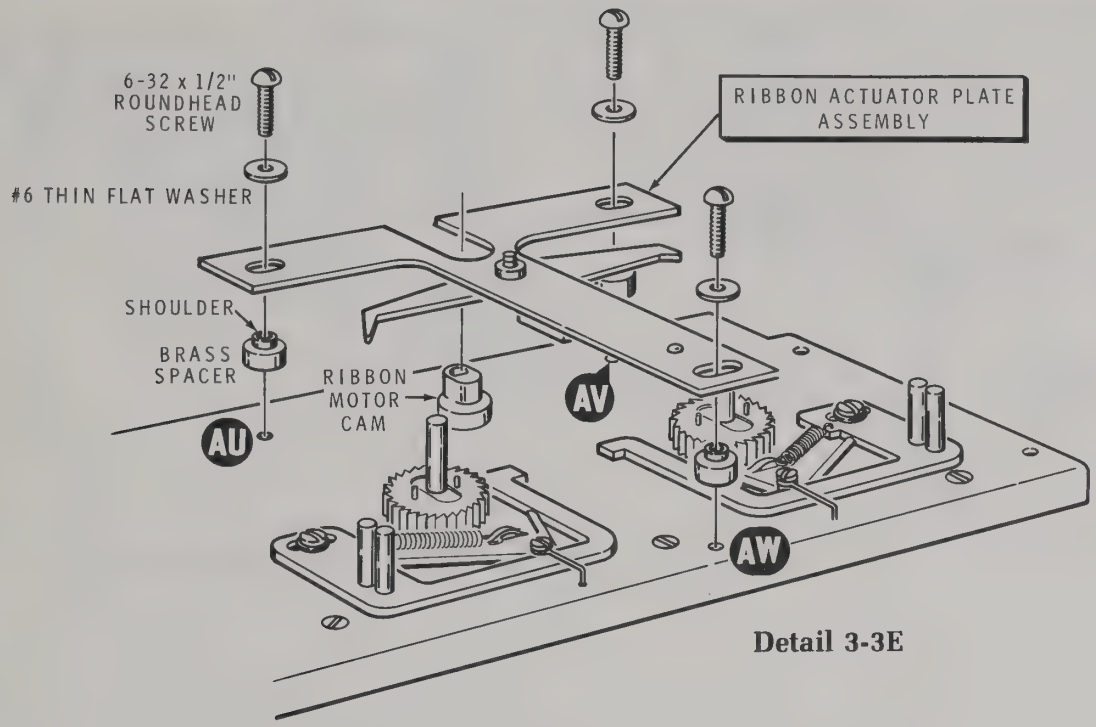
() 7. Place the pulley, recessed end down, on the head motor shaft over the pulley spring. Make sure the pin on the bottom of the pulley goes into the hole in the flat washer.

() 8. Place a Teflon washer on the head motor shaft and then place the large shaft collar (with the pins down) over the Teflon washer on the motor shaft. Make sure the pins on the large shaft collar straddle the pin on the pulley.

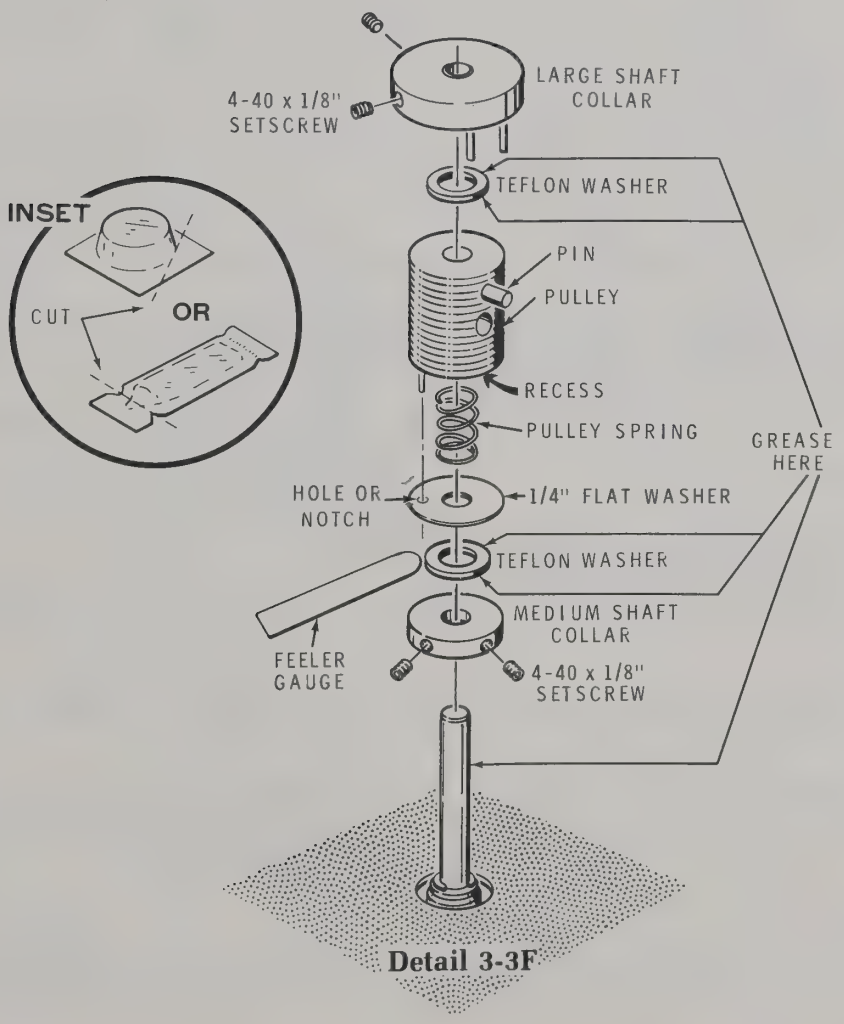
NOTE: It is alright if the pin does not hit the feeler gauge in the next step, however, be sure the pin does not touch the medium shaft collar.

() 9. Slide the edge of the feeler gauge in between the medium shaft collar and the flat washer so the pin hits the feeler gauge. Then press the large shaft collar down tight and tighten the setscrews.

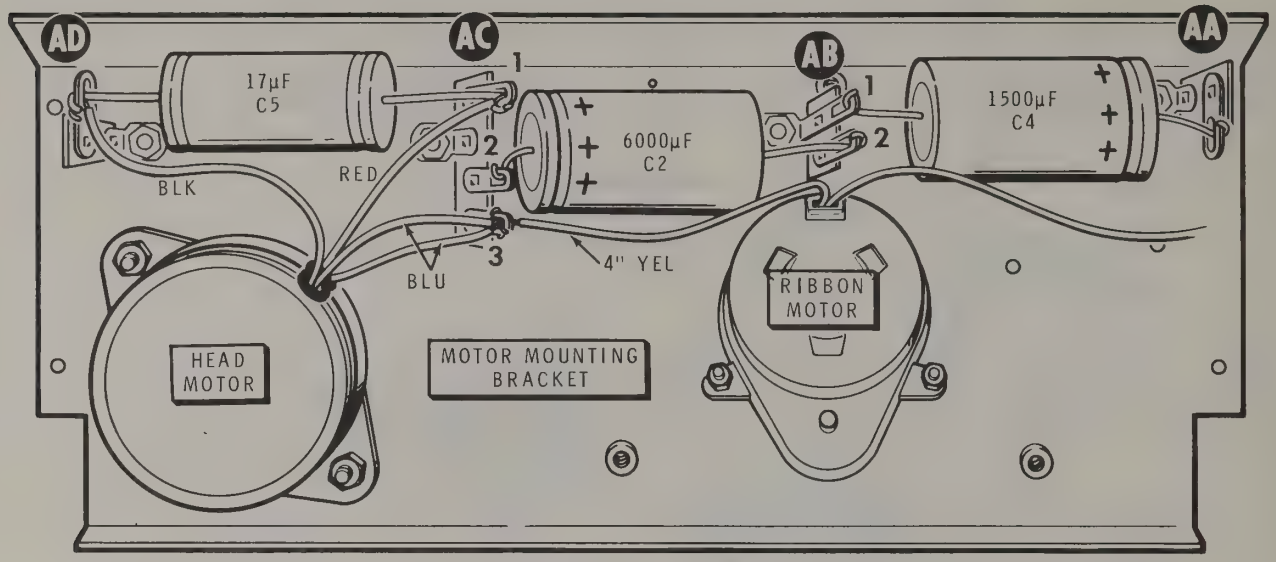
() 10. Remove the feeler gauge.



Detail 3-3E



Detail 3-3F



PICTORIAL 3-4

Refer to Pictorial 3-4 for the following steps.

() Position the motor mounting bracket as shown.

() Cut both leads of the 17 µF capacitor to 1".

() C5: Connect either lead of the 17 µF capacitor to terminal strip AD (NS). Connect the other lead to terminal strip AC lug 1 (NS).

() Cut both leads of the 6000 µF capacitor to 3/4".

() C2: Connect the lead at the plus (+) marked end of the 6000 µF capacitor to terminal strip AC lug 2 (NS). Connect the other lead to terminal strip AB lug 2 (NS).

() Cut both leads of the 1500 µF capacitor to 1".

() C4: Connect the lead at the plus (+) marked end of the 1500 µF capacitor to terminal strip AA (NS). Connect the other lead to terminal strip AB lug 1 (NS).

() Connect the head motor black lead to terminal strip AD (NS).

() Connect the head motor red lead to terminal strip AC lug 1 (NS).

() Connect the head motor two blue leads to terminal strip AC lug 3 (NS).

() Connect the ribbon motor 4" lead to terminal strip AC lug 3 (NS).

Set the assembled motor mounting bracket aside; it will be called for later.

CHASSIS ASSEMBLY

Refer to Pictorial 4-1 (Illustration Booklet, Page 7) for the following steps.

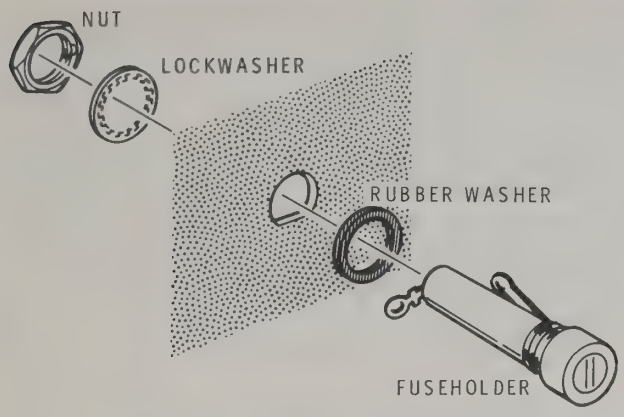
() Position the chassis on your work area as shown.

Refer to Detail 4-1A and mount the fuseholder as follows:

() 1. Open the package containing the fuseholder and its hardware.

() 2. Place the rubber washer on the body of the fuseholder.

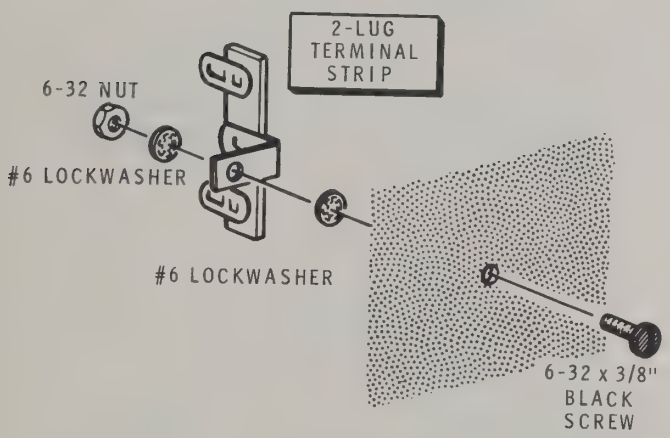
() 3. Insert the fuseholder into hole BA with the lug of the fuseholder positioned as shown in the Pictorial.



Detail 4-1A

() 4. Mount the fuseholder to the chassis with the lockwasher and nut furnished with the fuseholder. Do not overtighten the nut, or the fuseholder may break.

() Refer to Detail 4-1B and mount the large 2-lug terminal strip at hole BB with a 6-32 × 3/8″ black screw, two #6 lockwashers, and a 6-32 nut.



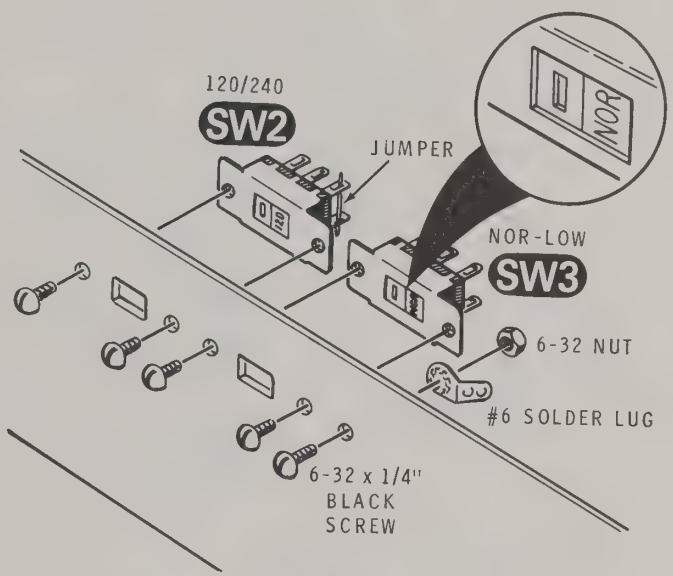
Detail 4-1B

Refer to Detail 4-1C for the next three steps.

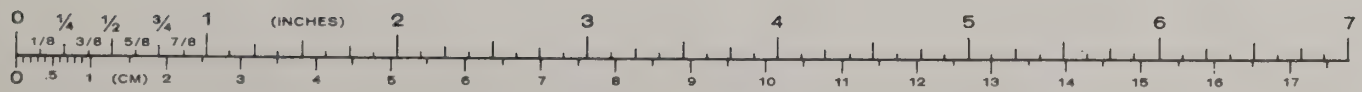
() 1. SW2: Mount the 120/240 switch with two 6-32 × 1/4″ black screws. Be sure the jumper is positioned as shown in the Pictorial.

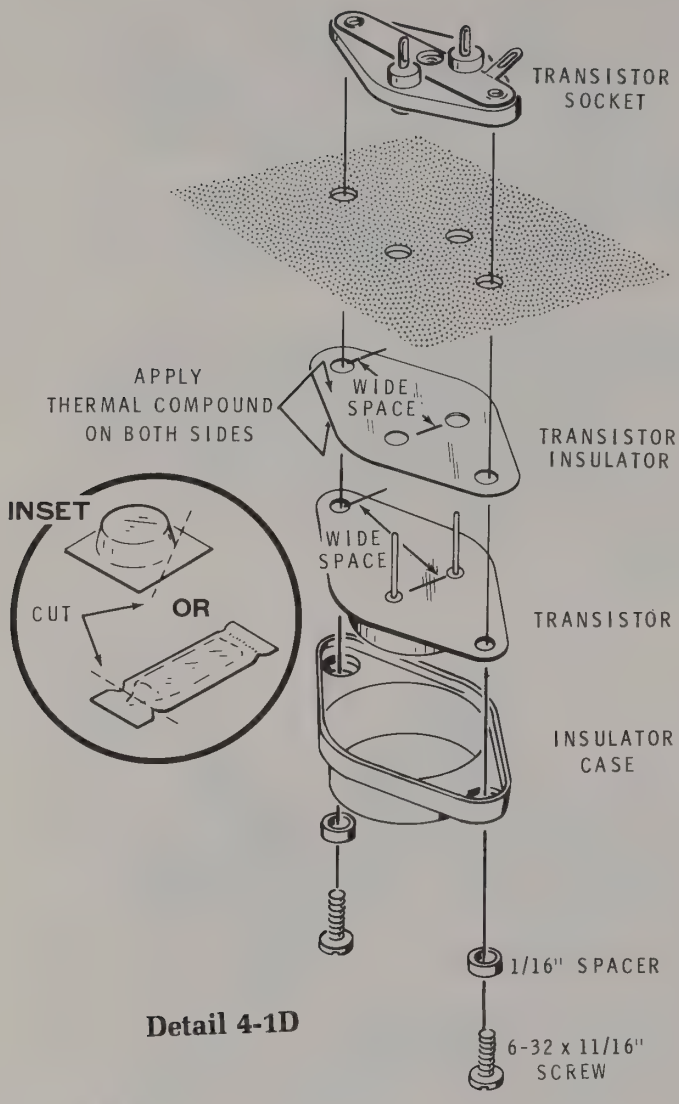
() 2. SW3: Mount the NOR/LOW switch with two 6-32 × 1/4″ black screws. Be sure the letters NOR and LOW are positioned as shown in the Detail.

() 3. Scrape the paint from around hole BC on the inside of the chassis. Then mount the #6 solder lug at hole BC with a 6-32 × 1/4″ black screw, and a 6-32 nut. Be sure the solder lug is positioned as shown in the Pictorial.



Detail 4-1C





Detail 4-1D

() Locate the following items:

MJ2941 transistor (#417-892)
Transistor insulator
Transistor insulator case
Transistor socket
Thermal compound (#352-31)
Two 6-32 × 11/16″ screws
Two 1/16″ spacers

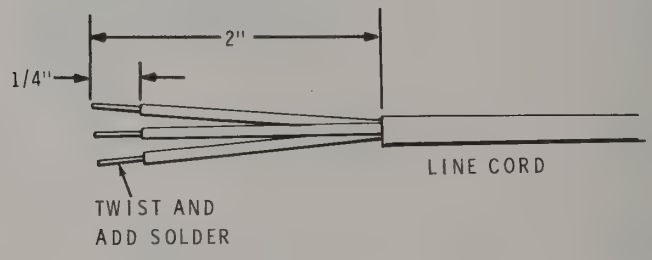
Refer to Detail 4-1D for the next three steps.

WARNING: You will be using Dow Corning 340 thermal heat sink compound in the next step and other steps in the Manual. Although the compound is not caustic, it may cause temporary discomfort if it gets into your eyes. If this happens, rinse your eyes with warm water. If the compound gets into your clothing, the clothing may require professional cleaning. The compound contains Zinc Oxides, SiO_2, and slight traces of CO_2.

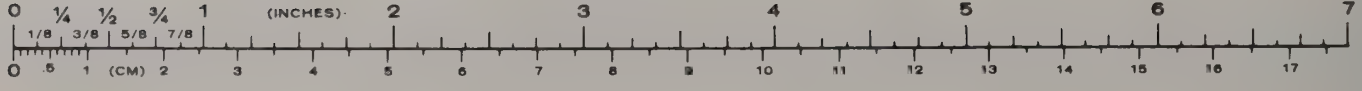
() 1. Refer to the inset drawing on Detail 4-1D and open the container of thermal compound. Apply a thin coating to both sides of the transistor insulator. Place the insulator on the transistor with the wide space positioned as shown.

() 2. Q1: Carefully observe the wide spacing on the transistor holes in the chassis at Q1 and place the socket on the underside of the chassis as shown in the Detail. Be sure the shoulders of the socket are centered in the two end holes. Then push the pins of the transistor into the socket through the holes in the chassis.

() 3. Make sure the socket shoulders are still centered in their holes, then place the insulator case over the transistor and secure it with two 6-32 × 11/16″ screws and 1/16″ spacers.



Detail 4-1E



() Refer to Detail 4-1E and prepare the line cord as shown. Twist the bare ends and add a small amount of solder to hold the fine strands together.

() Refer to Detail 4-1F and install the line cord and strain relief as follows:

1. Insert the prepared end of the line cord through hole BD in the chassis and through the hole in the shoulder of the strain relief.

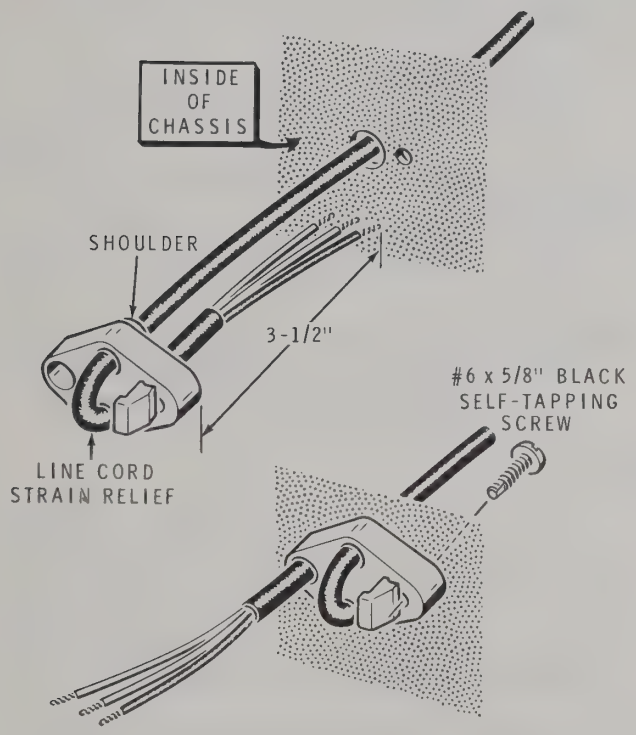
2. Route the end of the line cord back through the lower hole of the strain relief and pull it through for a distance of 3-1/2" as shown in the Detail.

3. Now route the end of the line cord through the hole in the side of the strain relief and pull it tight.

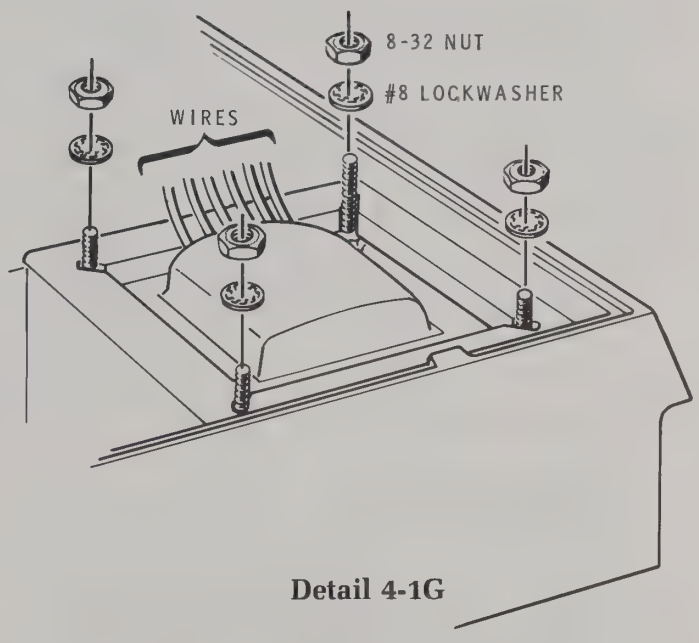
4. Mount the strain relief to the chassis with a #6 × 5/8" black self-tapping screw. Make sure the shoulder of the strain relief is centered in the chassis hole.

() If necessary, remove 1/4" of insulation from the lead ends of the power transformer.

() T1: Refer to Detail 4-1G and route the leads on the **bottom** of the transformer through the rectangular hole in the chassis and mount the transformer to the chassis with four #8 lockwashers and four 8-32 nuts.



Detail 4-1F



Detail 4-1G

NOTE: When you connect the wires shown in Pictorials 4-1 and 4-2 in the following steps, make mechanically secure connections. Refer to the inset drawing in Pictorial 4-1.

() Connect the black line cord wire to fuseholder BA lug 1 (S-1).

() Connect the white line cord wire to terminal strip BB lug 2 (NS).

() Connect the green line cord wire to the #6 solder lug (S-1).

() Prepare two 2-1/2" large black wires.

() Connect one end of a 2-1/2" large black wire to SW2 lug 2 (S-1); connect the other end to SW3 lug 2 (S-1).

() Connect one end of the other 2-1/2" large black wire to SW2 lug 5 (S-1); connect the other end to SW3 lug 5 (S-1).

Refer to Pictorial 4-2 (Illustration Booklet, Page 7) for the following steps.

() Cut both leads of a .01 μF capacitor to 3/4".

() C1: Connnect one lead of the .01 μF capacitor to terminal strip BB lug 1 (NS); connect the other lead to lug 2 (NS).

() Prepare the following wires.

4-1/2" large black
5" large black

() Connect one end of the 4-1/2" large black wire to SW2 lug 1 (S-1); connect the other end to terminal strip BB lug 1 (NS).

() Connect one end of the 5" large black wire to SW2 lug 6 (S-1); connect the other end to terminal strip BB lug 2 (NS).

() Loosely twist the six black transformer leads together and route them between the fuseholder and the strain relief close to the side of the chassis.

() Connect the black lead (no color stripe) coming from the transformer to terminal strip BB lug 1 (NS).

() Connect the black-red lead from the transformer to terminal strip BB lug 2 (S-4).

() Connect the black-white lead (not the black-gray) from the transformer to SW3 lug 3 (S-1).

() Connect the black-green lead from the transformer to SW3 lug 1 (S-1).

() Connect the black-gray lead from the transformer to SW3 lug 4 (S-1).

() Connect the black-yellow lead from the transformer to SW3 terminal 6 (S-1).

Refer to Pictorial 4-3 for the following steps.

() Position the chassis on your work area as shown.

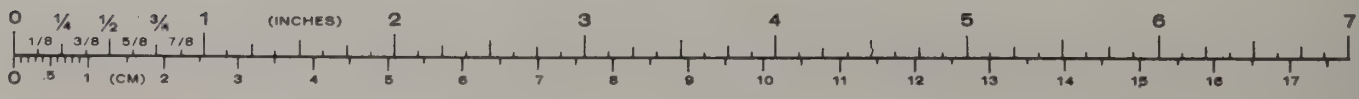
() **With a knife or other sharp tool, scrape the surfaces of the three mounting flanges and the three mounting bosses as shown. This will provide a good circuit board ground.**

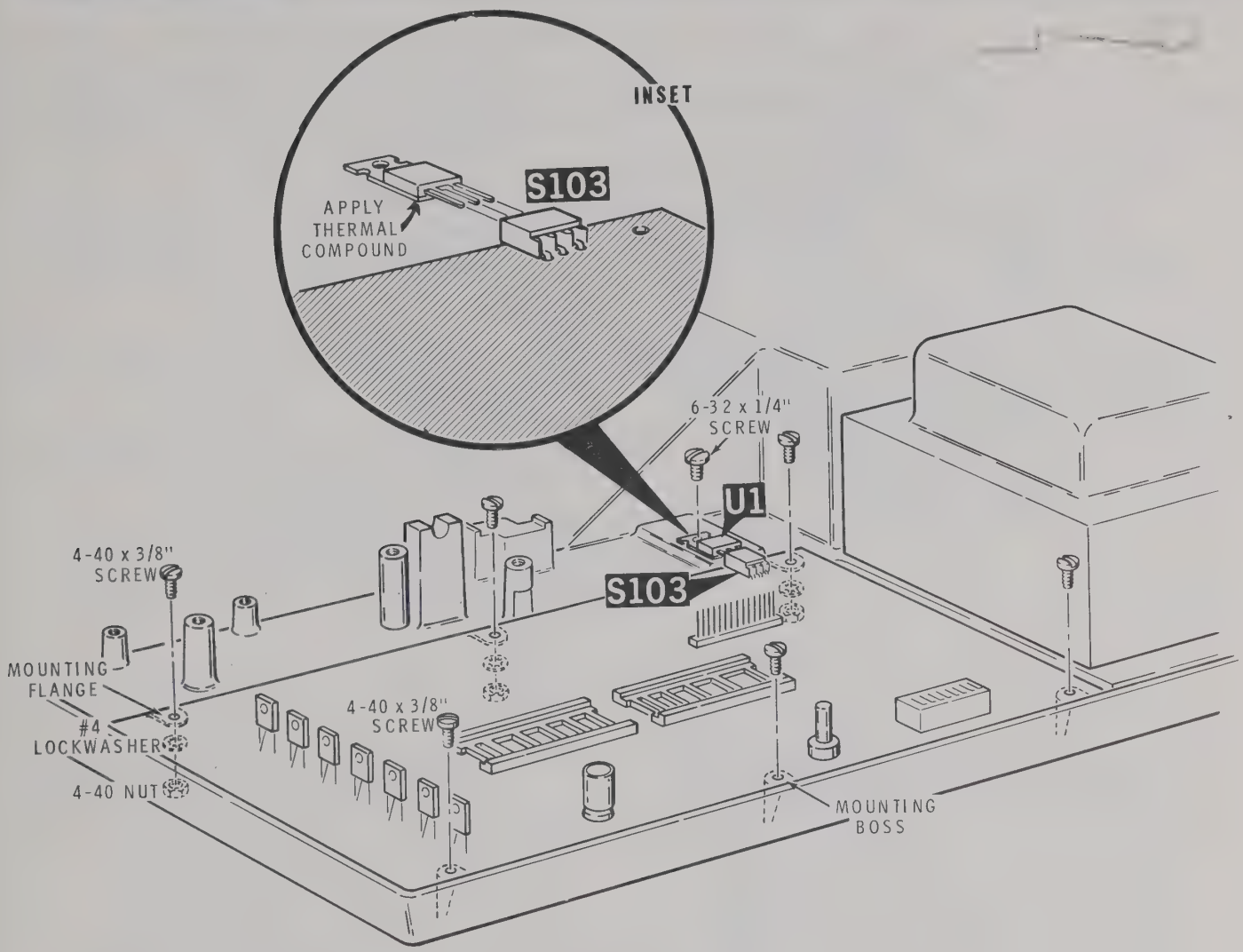
() U1: Refer to the inset drawing on the Pictorial and install the μA7805 integrated circuit (#442-54) in connector S103 on the circuit board. Make sure the IC is positioned as shown.

() Apply a thin coating of thermal compound to the bottom (metal side) of the IC.

() Mount the circuit board on the chassis with six 4-40 × 3/8" screws, three #4 lockwashers and three 4-40 nuts.

() Fasten U1 to the chassis with a 6-32 × 1/4" screw as shown.





PICTORIAL 4-3

Refer to Pictorial 4-4 (Illustration Booklet, Page 8) for the following steps.

() Position the chassis on your work area as shown.

() Refer to Detail 4-4A (Illustration Booket, Page 9) and shape the wiring harness as shown.

NOTE: In the following steps, the term "BO" (breakout) refers to a place where a group of wires come out of the harness. Each breakout is identified by a number, such as "BO#1."

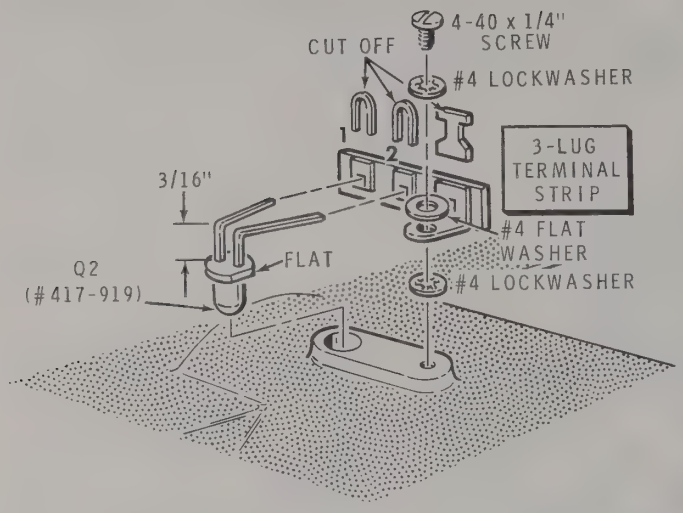
() Route the wiring harness and the transformer long orange lead as shown in the Pictorial.

() Route the connector at BO#1 through hole BF in the chassis; the connector should extend 6" through the hole.

() Route the two connectors from BO#2 through hole BG in the chassis; the two connectors should extend 1" through the hole.

() Route all the wires from BO#8 through the hole between the transformer and the circuit board to the other side of the chassis.

() Route the wires from BO#6 over the top of the chassis to the circuit board.



Detail 4-4B

Refer to Detail 4-4B for the next four steps.

() 1. Locate the 3-lug terminal strip and cut the three lugs flush with the top.

() 2. Q2: Bend the two leads of the TIL-78 transistor (#417-919) as shown; be sure the flat of the transistor is positioned as shown.

() 3. Insert the leads of the transistor into lug holes 1 and 2 of the terminal strip, then install the transistor in the unthreaded hole in the oblong mounting boss at Q2 on the chassis. Push the flat of the transistor against the boss.

() 4. Mount the terminal strip with two #4 lockwashers and a #4 flat washer and a 4-40 × 1/4" screw at hole BH as shown in the Pictorial.

() At BO#2, connect the inner lead of the shielded cable to terminal strip BH lug 2 (S-2).

() Connect the shield lead of the shielded cable to terminal strip BH lug 1 (S-2).

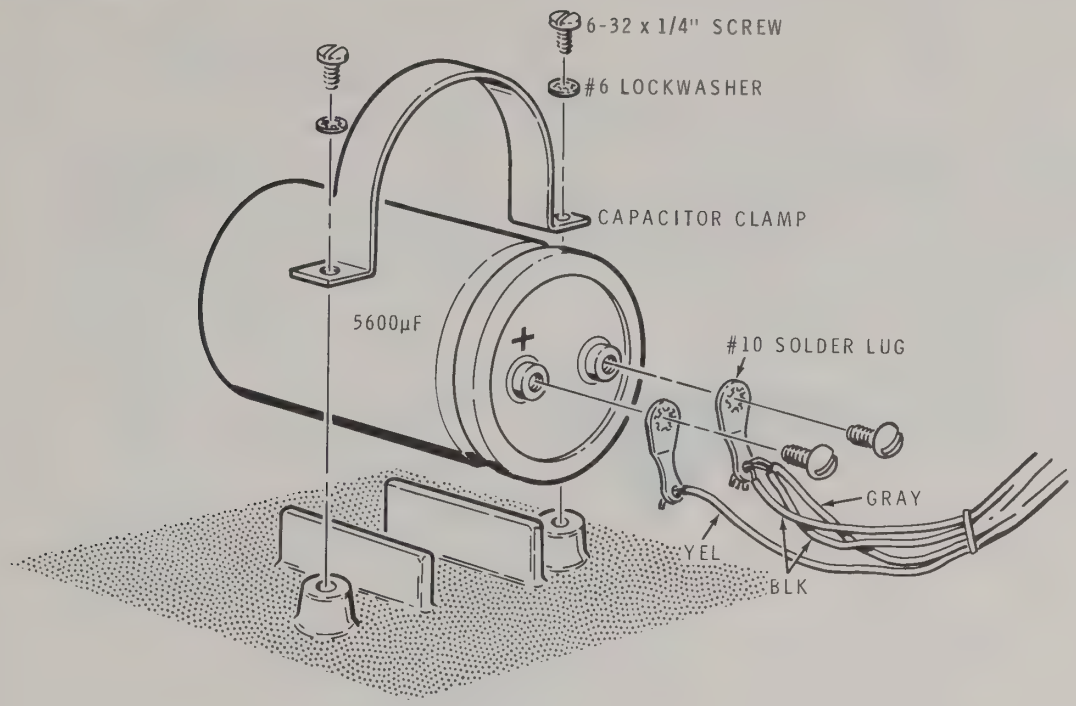
() Cut off the excess transistor lead lengths.

() Connect the red wire coming from BO#7 to the C (collector) lead of Q1 (S-1).

() Connect the violet wire coming from BO#7 to the E (emitter) lead of Q1 (S-1).

() At BO#7, connect the blue wire to the B (base) lead of transistor Q1 (S-1).





Detail 4-4C

Refer to Detail 4-4C for the next three steps.

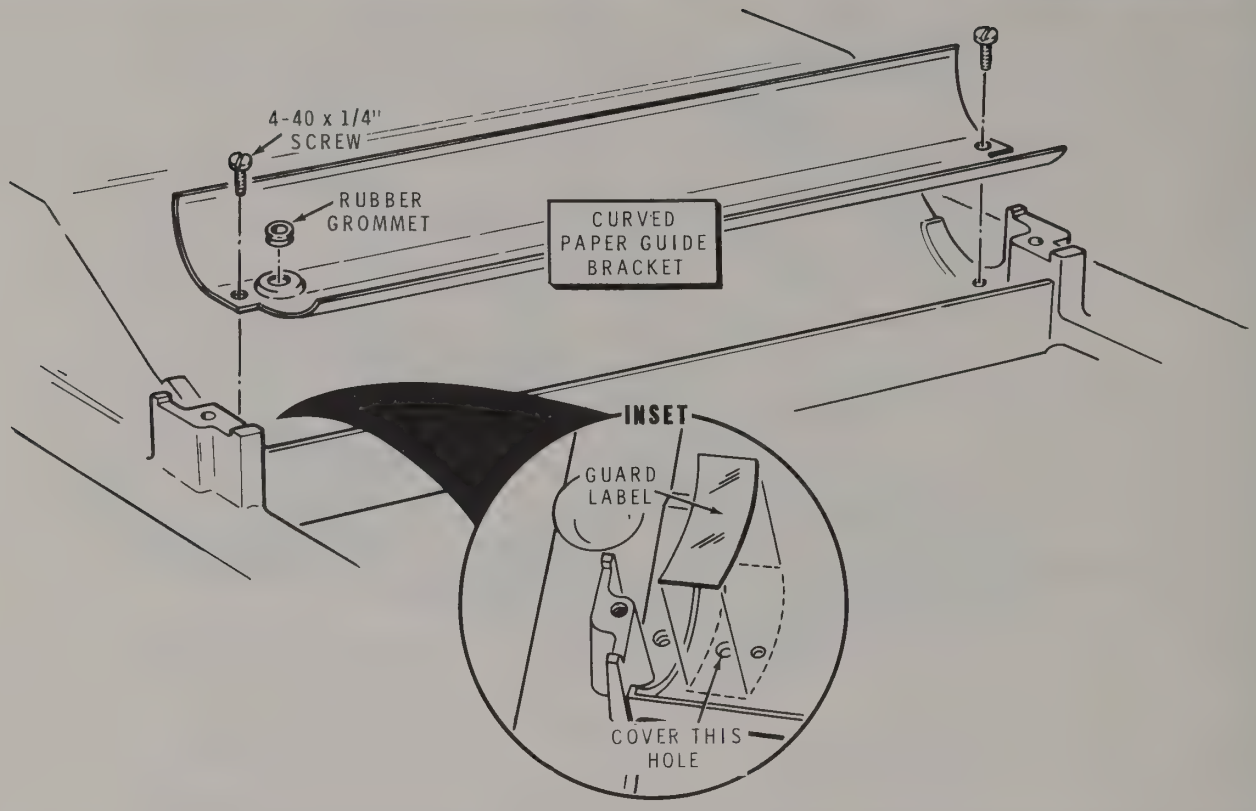
() 1. Connect the yellow wire coming from BO#7 of the wiring harness to a #10 solder lug (S-1). Then remove the screw from the plus (+) marked lug of the 5600 μF capacitor and mount the solder lug to the capacitor lug with the screw just removed. Discard any lockwashers supplied with the capacitor.

() 2. Connect the gray and two black wires coming from BO#7 to a #10 solder lug (S-3). Then remove the screw from the negative lug of the 5600 μF capacitor, and mount the solder lug to the capacitor with the screw just removed.

() 3. C3: Place the 5600 μF capacitor on the two embossed ridges on the chassis. Place the capacitor clamp over the capacitor and secure it with two 6-32 × 1/4" screws and #6 lockwashers. Tighten the screws just enough to hold the capacitor in place. Be sure the capacitor is centered under the clamp and the solder lugs are positioned as shown. Also make sure that the solder lugs are not touching other solder joints or the chassis.

Refer to Pictorial 4-5 (Illustration Booklet, Page 10) for the following steps.

() Position the chassis on your work area as shown.



Detail 4-5A

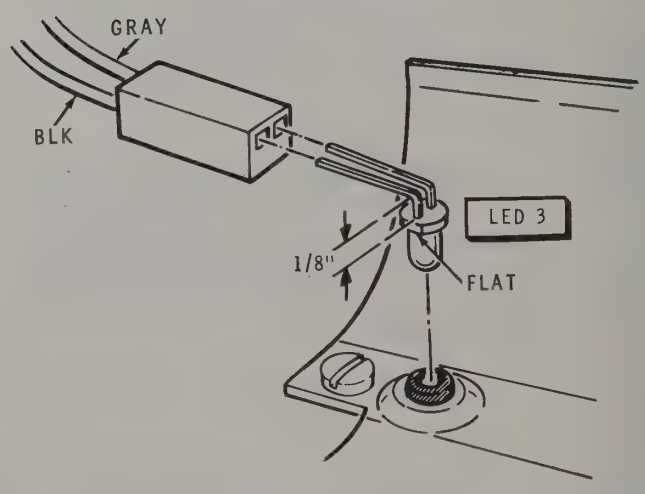
Refer to Detail 4-5A for the next three steps.

() Remove the adhesive backing from the clear plastic guard label. Then refer to the inset drawing in Detail 4-5A and press the label into place on the chassis. Make sure the label covers the hole shown.

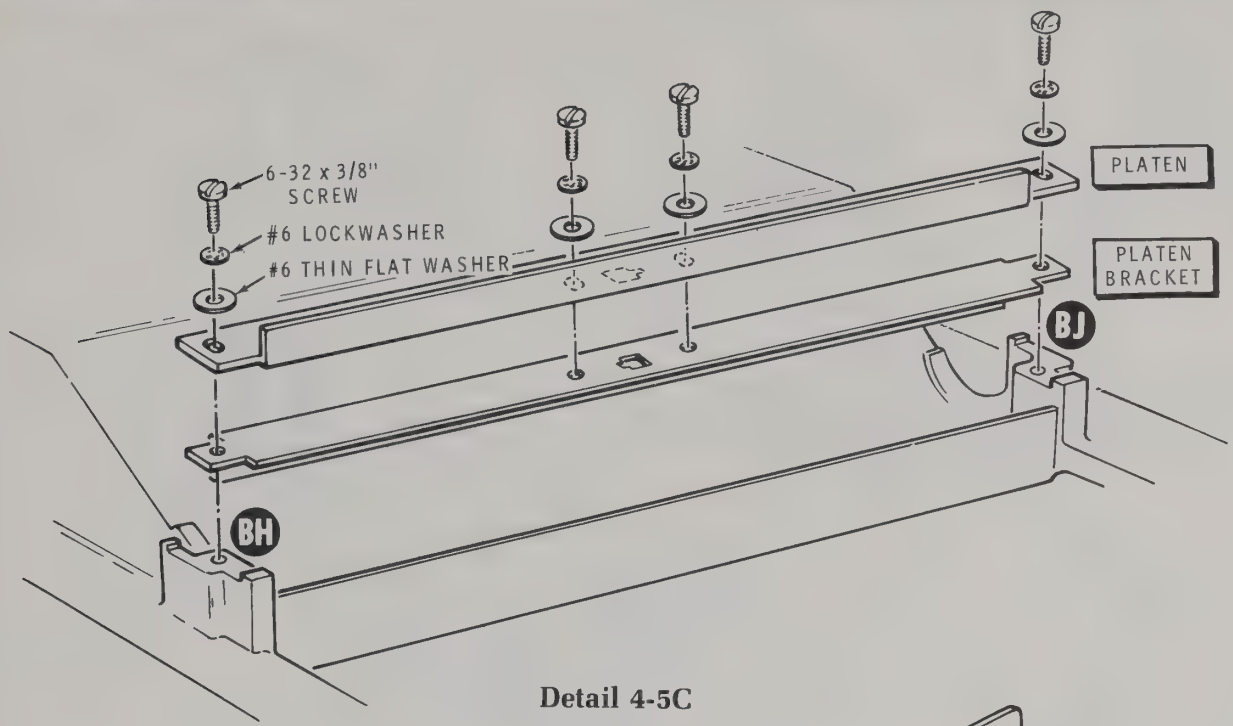
() Install a rubber grommet in the large hole in the curved paper guide bracket.

() Mount the curved paper guide bracket on the chassis with two 4-40 × 1/4″ screws.

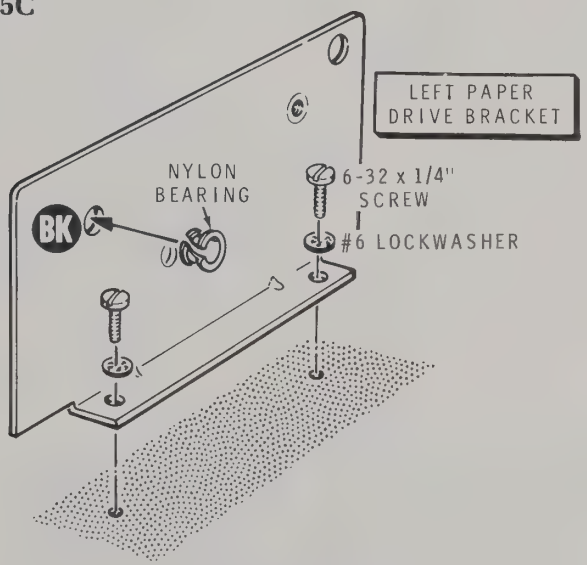
() LED3: Refer to Detail 4-5B and bend the leads of the LED (#412-635) as shown; be sure the flat of the LED is positioned as shown. Insert the leads of the LED into the connector coming from hole BF. Be sure the LED leads are not touching each other and that the lead on the flat side of the LED is installed in the connector side with the black wire. Then, install the LED into the grommet on the curved paper guide bracket.



Detail 4-5B



Detail 4-5C



Detail 4-5D

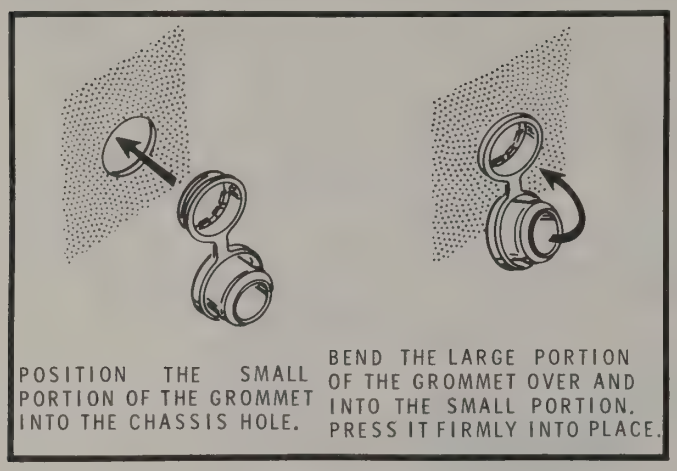
Refer to Detail 4-5C for the next two steps:

() Mount the platen to the platen bracket with two 6-32 × 3/8″ screws, #6 lockwashers, and #6 thin flat washers. Do not tighten the hardware at this time.

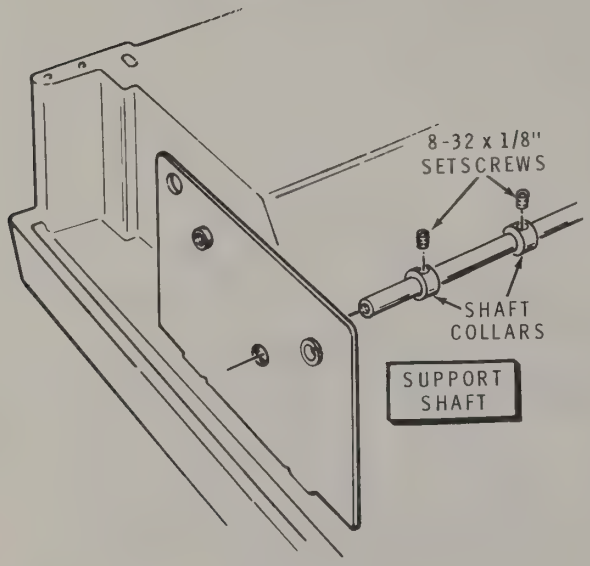
() Mount the assembled platen and platen bracket at holes BH and BJ with two 6-32 × 3/8″ screws, #6 lockwashers, and #6 thin flat washers. Be sure the platen and platen bracket are positioned as far to the rear of the chassis as possible.

() Refer to Detail 4-5D and install a snap-in nylon bearing in hole BK on the left paper drive bracket.

() Mount the left paper drive bracket with two 6-32 × 1/4″ screws, and #6 lockwashers.

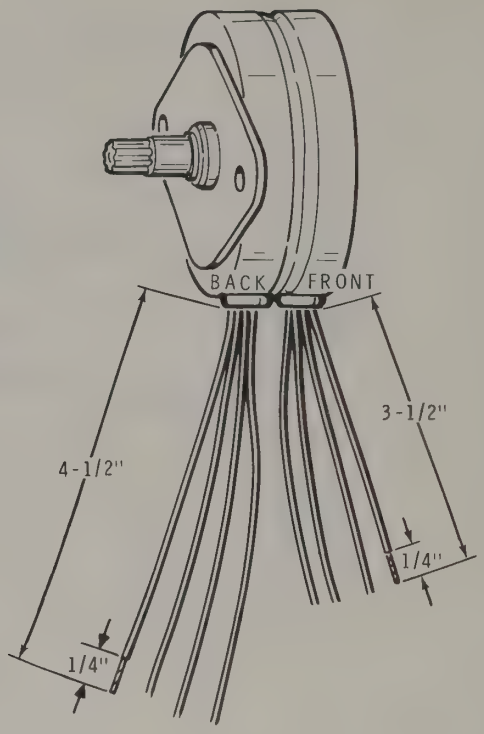


Detail 4-5E



Detail 4-5F

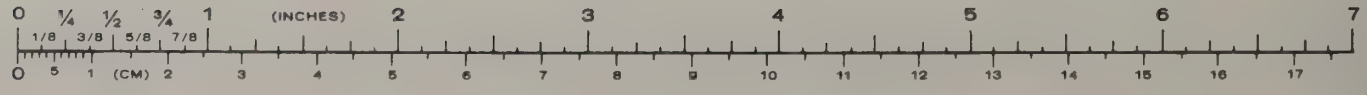
() Refer to Detail 4-5E and install the plastic grommet in hole BL on the left paper drive bracket. Make sure you install the grommet from the inside of the bracket as shown in the Pictorial.

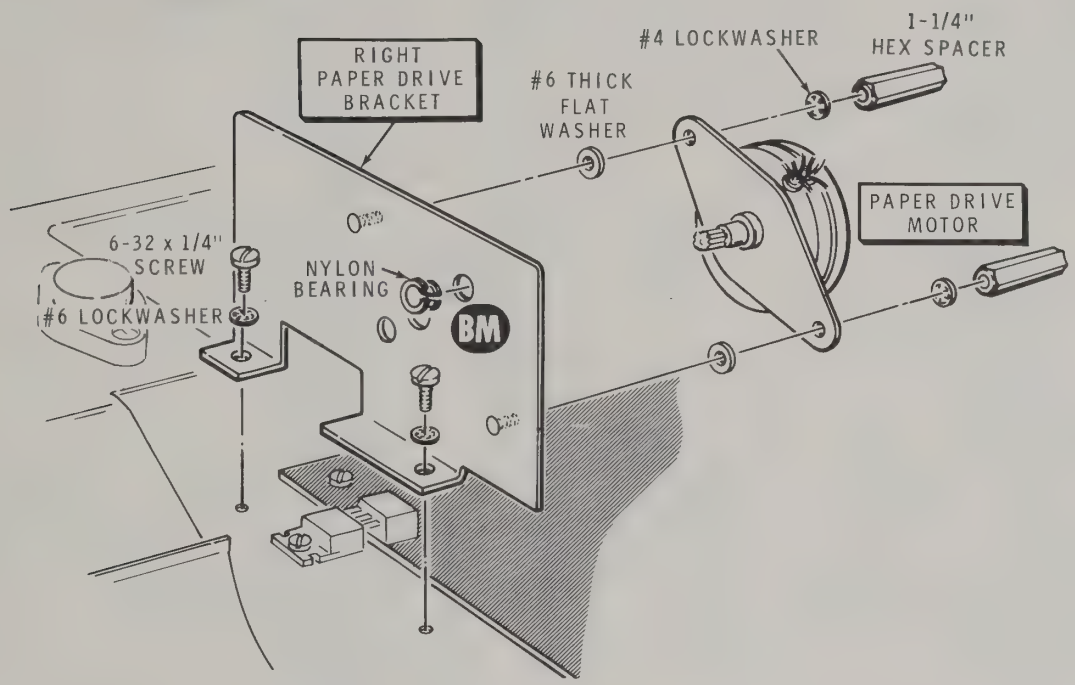


Detail 4-5G

() Refer to Detail 4-5F and install 8-32 × 1/8″ setscrews in the two small shaft collars. Position the small shaft collars midway on the 12-1/4″ × 1/4″ support shaft and just tighten the setscrews. Insert the end of the shaft through the lower hole in the left paper drive bracket; allow the shaft to extend 1″ through the hole.

() Locate the paper drive motor. Then refer to Detail 4-5G and cut the **front** leads to 3-1/2″ and the **back** leads to 4-1/2″. Measure the leads from where they come out of the motor. Then remove 1/4″ of insulation from the end of all leads.





Detail 4-5H

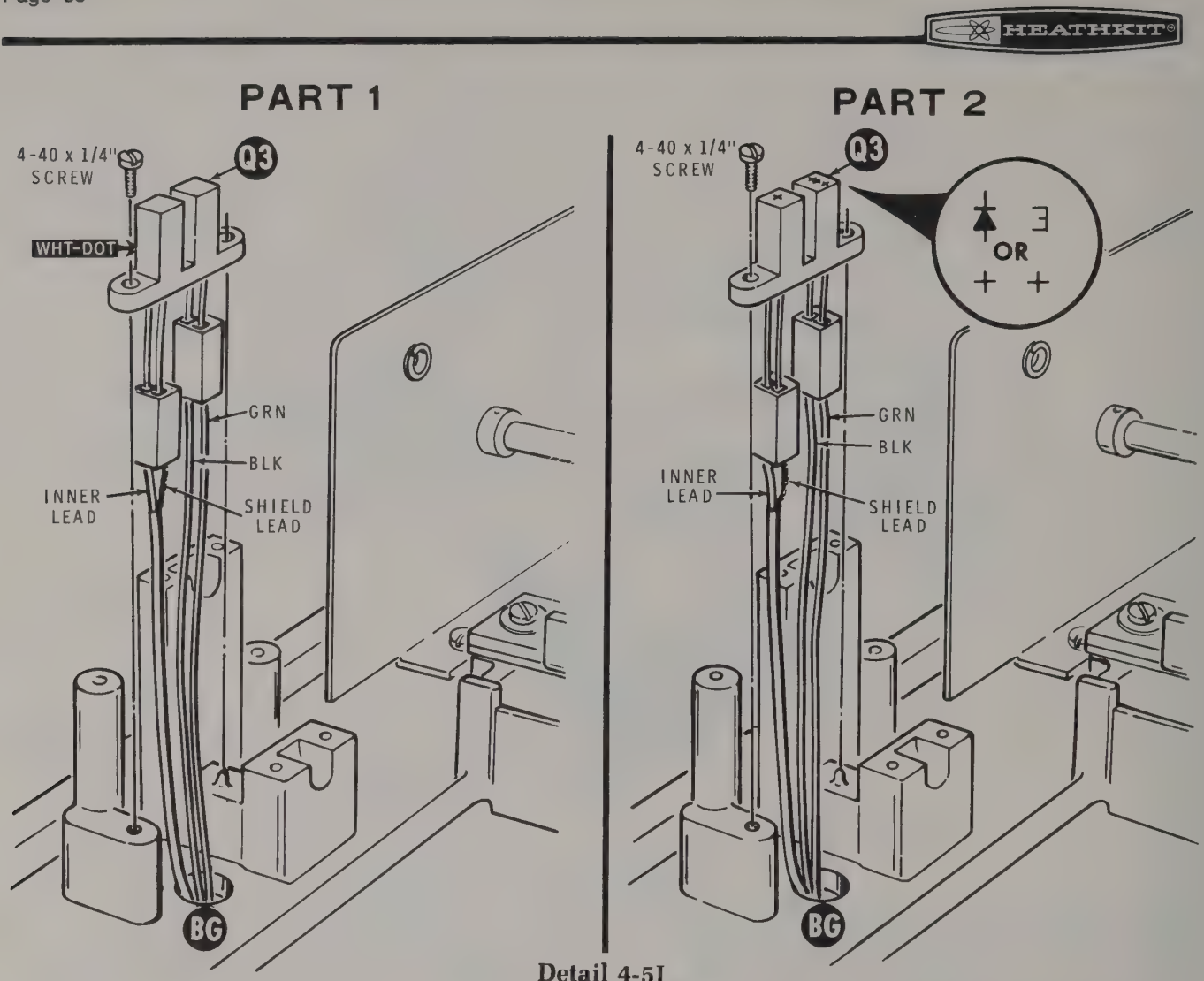
Refer to Detail 4-5H for the next three steps:

() Install a snap-in nylon bearing in hole BM on the right paper drive bracket.

() Mount the paper drive motor with two #6 thick flat washers, # 4 lockwashers, and 1" hex spacers. Be sure the paper drive motor is positioned as shown. Tighten the hardware only finger tight at this time.

() Mount the assembled right paper drive bracket with two 6-32 × 1/4" screws, and #6 lockwashers.

() Install the support shaft with the two small shaft collars into the bottom hole on the right paper drive bracket until it just touches the paper drive motor. Loosen the setscrews in the shaft collars and position the shaft collars against the left and right paper drive brackets and then tighten the setscrews.



Detail 4-5J

NOTE: In the next step, if the optical switch (#150-74) has a white dot on its side, refer to Detail 4-5J Part 1; if it has plus (+) markings on its top, refer to Detail 4-5J Part 2.

() Q3: Cut the leads of the optical switch to 3/8". Then insert the leads into the two connectors routed through hole BG; be sure the connectors are positioned as shown in the appropriate Detail.

() Push the optical switch and the connectors down while pulling the connector wires through hole BG until the connectors are positioned between the mounting bosses, and the optical switch is seated on the mounting bosses. Be sure the raised circular boss is inserted in the mounting hole.

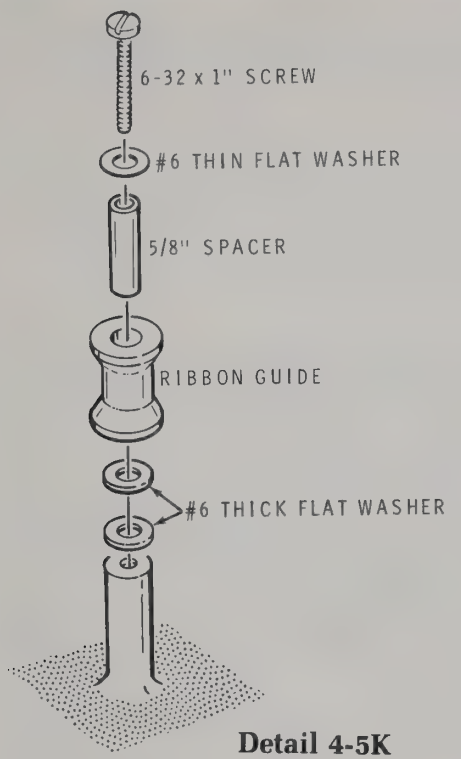
() Secure the optical switch with a 4-40 × 1/4" screw.

() Refer to Detail 4-5K and install ribbon guides on mounting bosses BP and BQ. Use two #6 thick flat washers, a 5/8" spacer, a #6 thin flat washer and a 6-32 × 1" screw at each location.

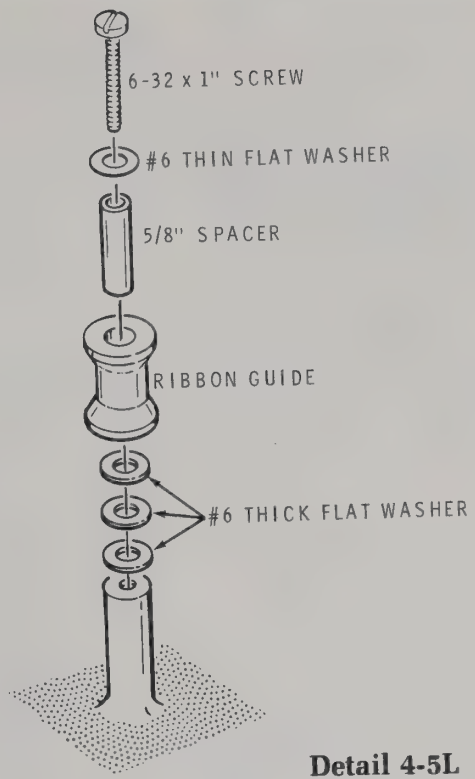
() Refer to Detail 4-5L and install a ribbon guide on mounting boss BN. Use three #6 thick flat washers, a 5/8" spacer, a #6 thin flat washer, and a 6-32 × 1" screw at this location.

() In a similar manner, install a ribbon guide at mounting boss BR. Use a 5/8" spacer, a #6 thin flat washer, and a 6-32 × 1" screw at this location. IMPORTANT: **Do not** use any #6 thick flat washers to mount this ribbon guide.

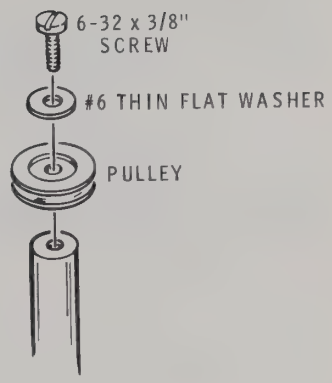
NOTE: You may have some #6 thick flat washers left over when your kit is completed.



Detail 4-5K



Detail 4-5L



Detail 4-5M



Detail 4-5N

() Refer to Detail 4-5M and mount a pulley at BS and BT with 6-32 × 3/8″ screws, and #6 thin flat washers.

() Refer to Detail 4-5N and mount the two spring retainer pins at holes BU and BV with #6 thick flat washers as shown.

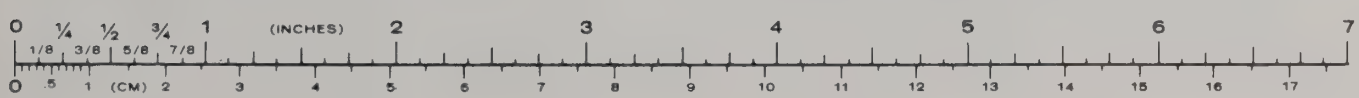
Refer to Part A of Pictorial 4-6 (Illustration Booklet, Page 11) for the following steps. NOTE: The following Details are also shown on Page 11 in the Illustration Booklet.

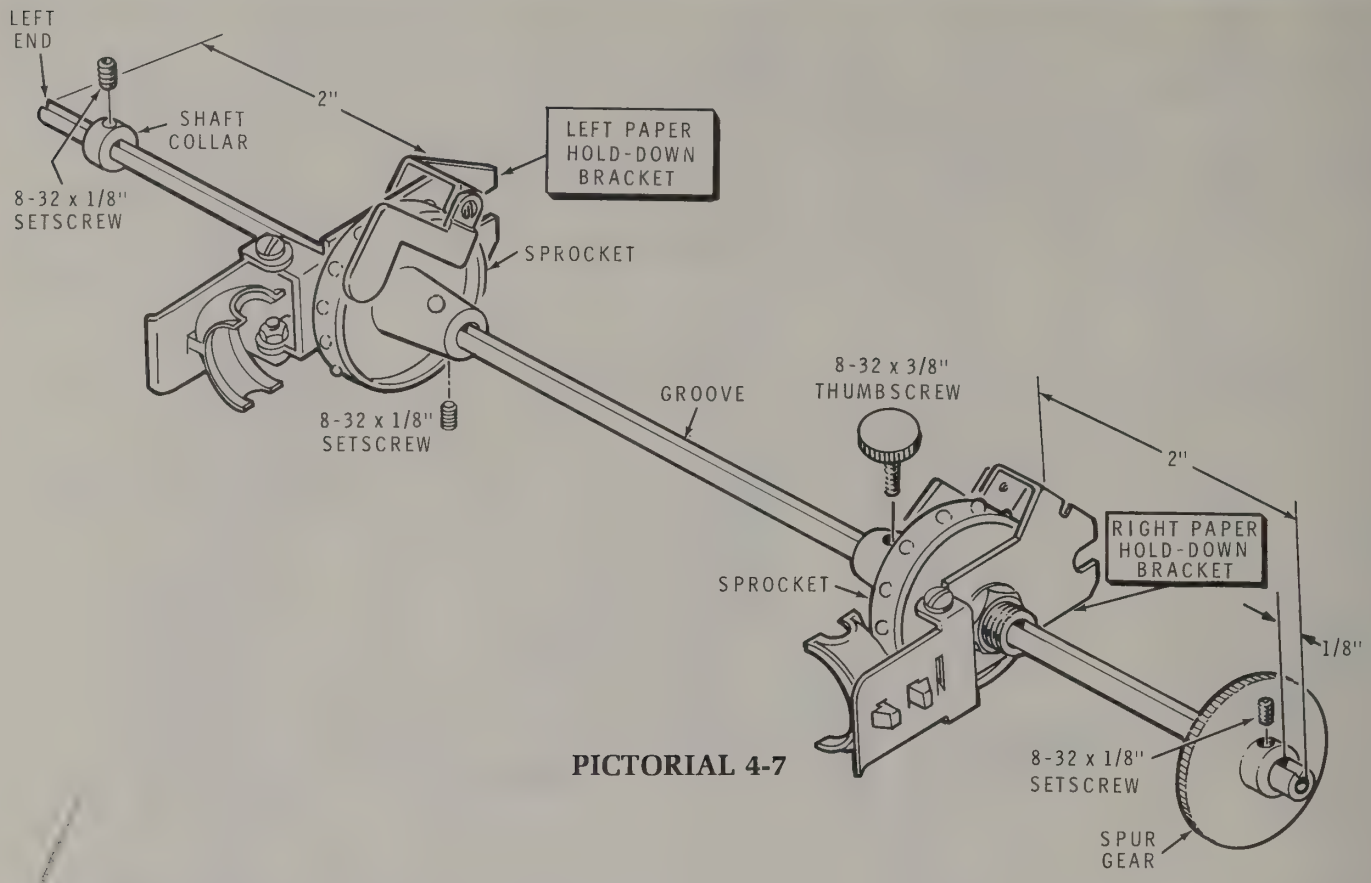
() Refer to Detail 4-6A and mount a threaded bushing on the right paper hold-down bracket with a 3/8″ lockwasher, and a 3/8-32 nut.

NOTE: In the next step, make sure one of the spacers on the pivot bracket is half way through its hole.

() Refer to Detail 4-6B and place a 9/64″ spacer in each hole on a hold-down pivot bracket. Be sure the spacers are positioned as shown in the Pictorial. Mount the hold-down pivot bracket and the spacers to the right paper hold-down bracket with two 4-40 × 3/8″ screws, #4 lockwashers, and 4-40 nuts.

() Using long-nose pliers, hook one end of a paper hold-down spring to the hold-down pivot bracket as shown. Then hook the free end of the spring to the right paper hold-down bracket as shown in the Pictorial.





PICTORIAL 4-7

() Operate the pivot bracket (and readjust it if necessary) to be sure it snaps smoothly back and forth.

() Refer to Detail 4-6C and install a paper lifter with a 2-56 × 1/4" screw as shown.

() Refer to Detail 4-6D and install a paper hold-down on the hold-down pivot bracket.

() Refer to Part B of Pictorial 4-6 and in a similar manner, assemble the left paper hold-down bracket.

Refer to Pictorial 4-7 for the following steps.

() Place the sprocket in the left paper hold-down bracket.

() Make sure the sprocket hub is positioned as shown in the Pictorial. Mount the sprocket, the left paper hold-down bracket and the hold-down pivot bracket as an assembly on the left end of the grooved shaft. Note that the sprocket is "keyed" to fit correctly onto the shaft in only one position.

() Install an 8-32 × 1/8" setscrew into the underside of the sprocket as shown.

() Position the assembly 2" from the end of the shaft and tighten the setscrew just slightly. Be sure the sprocket hub is positioned as shown.

() Place the other sprocket (with the hub positioned as shown in the Pictorial) in the right paper hold-down bracket.

() Mount the sprocket, the right paper hold-down bracket, and the hold-down pivot bracket as an assembly on the right end of the grooved shaft. Position the assembly 2" from the right end of the shaft.

() Install the 8-32 × 3/8" knurled thumbscrew in the other sprocket and tighten the thumbscrew. Be sure the sprocket is positioned so the thumbscrew is **over** the groove in the shaft.

() Install an 8-32 × 1/8″ setscrew in the hub of the spur gear; do not thread the setscrew all the way into the spur gear.

() Place the spur gear on the right end of the grooved shaft and be sure the setscrew is over the groove in the shaft. Position the spur gear 1/8″ from the end of the shaft and tighten the setscrew.

() Install an 8-32 × 1/8″ setscrew in the small shaft collar and install the shaft collar on the left end of the grooved shaft. Do not tighten the setscrew.

Set the paper drive assembly aside until it is called for later.

Refer to Pictorial 4-8 (Illustration Booklet, Page 12) for the following steps,

Position the chassis as shown in the Pictorial.

() Carefully remove the print head from its container and unwind the cable assembly from the print head.

Refer to Detail 4-8A (Illustration Booklet, Page 12) for the next five steps.

() 1. Remove the packing material from the print head package and place the print head with the print face down on the packing material.

() 2. Mount the head drive bracket to the print head with two #4 × 7/16″ self-tapping screws and 7/32″ spacers.

() 3. Insert the 10-5/8″ × 1/4″ shaft through the bottom hole of the print head.

() 4. Insert the 11-3/4″ × 5/16″ shaft through the top hole of the print head.

() 5. Place a felt washer on each end of the 10-5/8″ × 1/4″ shaft.

CAUTION: To prevent damage to the printing mechanism in the next step, loosen the two end screws securing the platen and the platen bracket to the chassis and the two screws securing them to each other. Then move the platen and the platen bracket to the rear of the chassis away from you.

() Carefully place the small (1/4″) diameter shaft in position on the chassis at BW and BX and the large (5/16″) diameter shaft in position at BY and BZ.

() Mount the print head shafts to the chassis with four shaft retainer plates and eight 4-40 × 1/4″ screws and then position the felt washers against the mounting bosses.

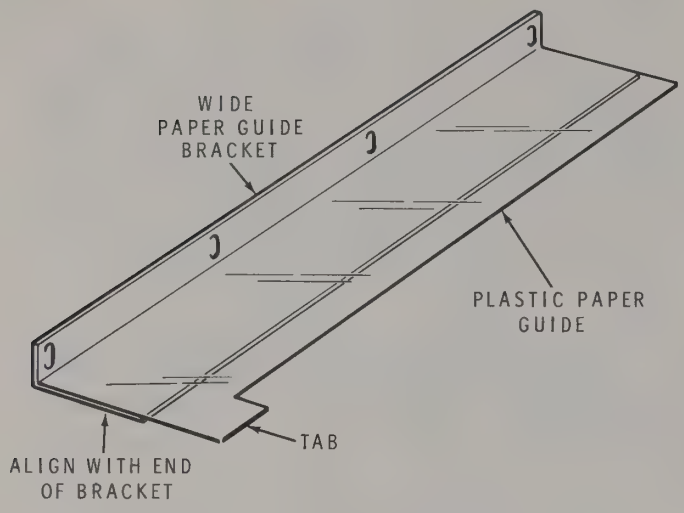
Refer to Pictorial 4-9 (Illustration Booklet, Page 12) for the following steps.

NOTE : In the next step, the platen mounting screws must be snug, but just loose enough to allow the platen to be moved with a screwdriver.

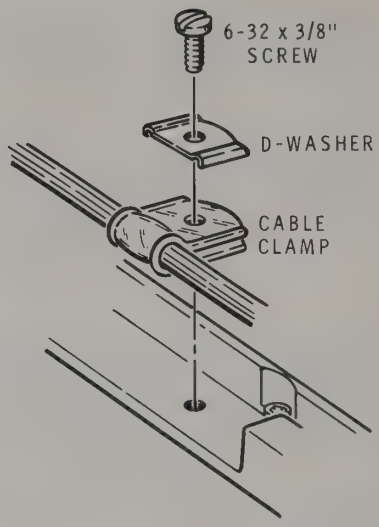
() Loosen the end two platen mounting screws. Using the .015″ feeler gauge, adjust the spacing between the nose of the print head and the platen at each end of the print head travel. Then retighten the screws.

() Loosen the two screws securing the platen and the platen bracket together. Carefully move the print head to the center of the platen and, using the .015″ feeler gauge, adjust the spacing between the platen and the nose of the print head. Tighten the two screws securely.

() Recheck, and if necessary, readjust the spacing between the nose of the print head and the platen at each end and the center of the print head travel. Then tighten all the screws securely.



Detail 4-10A



Detail 4- 10B

Refer to Pictorial 4-10 (Illustration Booklet, Page 13) for the following steps.

() Position the chassis on your work area as shown.

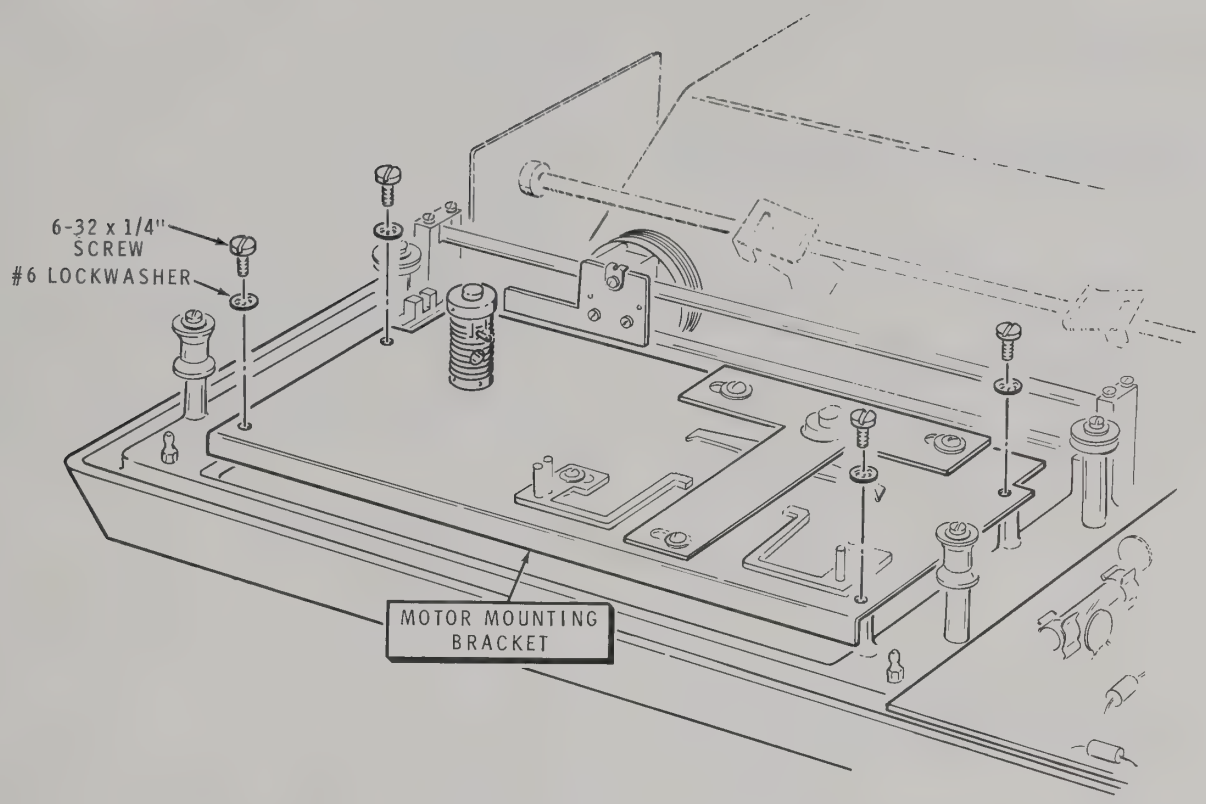
() Place a piece of tape (any kind) around the print head cable 13″ from the print head as shown in the inset drawing on the Pictorial. NOTE: Do not place the tape on the cable wrap. Cut off part of the cable wrap if necessary. Be careful not to cut any of the cable wires.

() Wind the print head cable assembly six turns (in the direction shown) on the cable guide shaft. Then mount the cable guide shaft at CA and CB with two shaft retainer plates and four 4-40 × 1/4″ screws.

() Refer to Detail 4-10A and position the wide paper guide bracket on your work area as shown. Remove the protective strip from the plastic paper guide and press the paper guide on the wide paper guide bracket with the tab positioned as shown in the Detail. Make sure the paper guide is aligned and even with the end of the bracket as shown.

() Mount the wide paper guide bracket with four 4-40 × 1/4″ screws and #4 lockwashers. Position it as far to the rear as possible before you tighten the screws.

() Place the small cable clamp on the print head cable assembly over the tape. Then refer to Detail 4-10B and mount the cable clamp at hole CC with a D-washer and a 6-32 × 3/8″ screw.



PICTORIAL 4-11

Refer to Pictorial 4-11 for the following steps.

() Position the chassis on your work area as shown.

NOTE: In the next step, be sure that the wires are not pinched between the motor mounting bracket and the bosses on the chassis.

() Position the motor mounting bracket on the chassis as shown in the Pictorial. Mount the motor mounting bracket with four 6-32 × 1/4" screws and #6 lockwashers.

WIRING

Refer to Pictorial 5-1 (Illustration Booklet, Page 14) for the following steps.

NOTE: When you connect leads and wires to the circuit boards in the following steps, solder each one as you install it and cut off the excess lead or wire ends on the foil side of the circuit boards.

Connect the wires from BO#8 of the wiring harness to the circuit board as follows:

() Either black wire to AD.

() Other black wire to AA.

() Yellow wire to W.

() Violet wire to X.

() Blue wire to Y.

NOTE: One of the shielded cables is marked near the end for identification as shown in the Pictorial. DO NOT connect the marked cable by mistake in the following two steps.

() **Unmarked** shielded cable inner lead to C.

() **Unmarked** shielded cable shield lead to D.

() Marked shielded cable shield lead to K.

() Marked shielded cable inner lead to J.

() Green wire to A.

() Gray wire to B.

() Orange wire to AH.

() Route the ribbon motor yellow lead between the two motor mounting plate mounting bosses and connect this lead to circuit board hole AM (S-1).

Connect the wires from BO#6 of the wiring harness to the circuit board as follows:

() Violet wire to AQ.

() Black wire to AP.

() Blue wire to AN.

() Red wire to Z.

() Brown wire to AO.

() Temporarily mount the stepper driver circuit board to the front spacer (as shown in the Pictorial) on the paper drive motor with a 4-40 × 1/4" screw. Lift the back corner of the board upward as shown by the arrow. This will hold the circuit board in place while you connect the motor leads in the following steps.

Connect and solder the leads coming from the paper drive motor to the stepper driver circuit board as follows:

() Front black to H.
() Front gray to AI.
() Front red to J.
() Front yellow to AG.
() Back red to L.
() Back gray to AL.
() Back black to K.
() Back yellow to AJ.

() Loosen the screw that holds the stepper driver circuit board to the front spacer. Then position the rear corner of the circuit board down to its permanent location as shown in the Pictorial. Install a 4-40 × 1/4" screw in the back spacer. Leave both mounting screws **slightly** loose at this time.

NOTE: In the following steps, you will connect the wires coming from the stepper drive circuit board to the main circuit board. Most of the wires will connect to holes that were previously intended for component leads. Make sure you connect each wire to the correct hole.

() Green to hole AE.

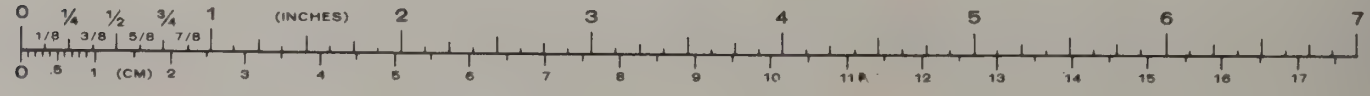
() Yellow to B (base) hole of Q121.

() Orange to the hole at the **banded** end of D114.

() Black to E (Emitter) hole of Q120.

() White-yellow to B (base) hole of Q120.

() Gray to B (base) hole of Q123.



() White-gray to B (base) hole of Q122.

() Solder the red wire to the main circuit board at hole Z. There is another red wire soldered in the hole at this location.

Refer to Pictorial 5-2 (Illustration Booklet, Page 14) for the following steps.

Connect the six short leads coming from the transformer to the circuit board as follows:

() Green-yellow lead to N.

() Either red lead to O.

() Other red lead to P.

() Either green lead to Q.

() Other green lead to R.

() Orange lead to M.

Connect the wires of the 8-wire cable and the single black wire coming from the switch assembly to the circuit board as follows:

() Violet wire to AC.

() Gray wire to L.

() Brown wire to AB.

() Small black wire to AR.

() Red wire to E.

() Orange wire to F.

() Yellow wire to G.

() Green wire to H.

() Blue wire to I.

() Refer to the inset drawing on the Pictorial and tie the nine wires with a cable tie positioned as shown in the Pictorial, then cut off the excess cable tie length.

NOTE: Some circuit board holes are not used.

Refer to Pictorial 5-3 (Illustration Booklet, Page 15) for the following steps.

Turn the chassis over and position it as shown in the Pictorial.

Connect the wiring harness wires and the long orange lead from the transformer to the motor mounting plate as follows:

() Long orange lead from the transformer to terminal strip AC lug 3 (S-4).

() Violet wire from BO#5 to terminal strip AA lug 1 (S-2).

() Three black wires from BO#4 to terminal strip AB lug 2 (S-4).

() Gray wire from BO#4 to terminal strip AB lug 1 (S-2).

() Brown wire from BO#3 to terminal strip AC lug 1 (S-3).

() Orange wire from BO#3 to terminal strip AC lug 2 (S-2).

() Blue wire from BO#3 to terminal strip AD lug 1 (S-3).

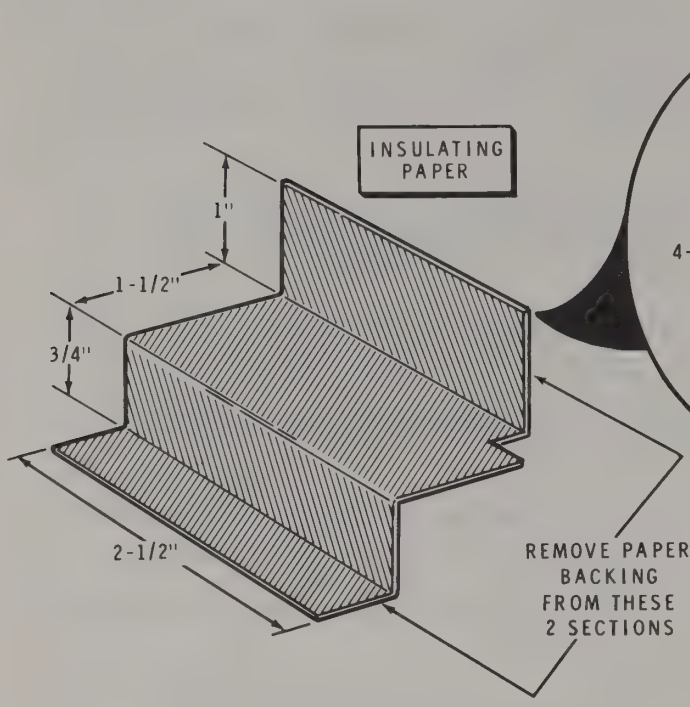
() Tie the orange lead from the transformer into the wiring harness using seven cable ties spaced evenly along the cable harness as shown in the Pictorial. Cut off the excess cable tie lengths after they are installed. Position the cable harness neatly on the chassis.

Refer to the inset drawing on the Pictorial for the next three steps.

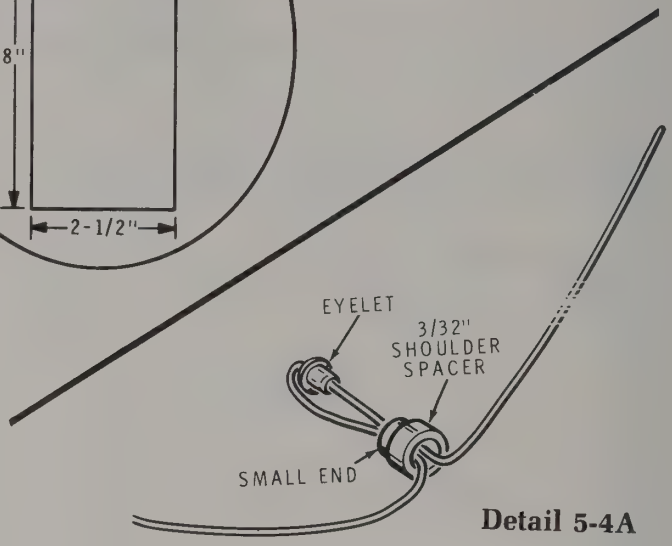
() Place the switch assembly near the chassis and route the two large black wires coming from the switch assembly up through chassis hole BE.

() Connect either of the large black wires to fuseholder BA lug 2 (S-1).

() Connect the other large black wire to terminal strip BB lug 1 (S-4).



Detail 5-3A



Detail 5-4A

Refer to Detail 5-3A for the next two steps.

() 1. Position the 2-1/2" × 4-1/8" insulating paper as shown in the inset drawing and cut a 1-1/4" × 1/4" piece from the top right corner.

() 2. Fold the insulating paper according to the dimensions shown in the Detail.

() Test fit the prepared insulating paper over transistor Q1 socket as shown in the Pictorial with the two wires coming through hole BE positioned in the cutout. Position these wires as far as possible away from the indicated chassis hole. Then remove the backing paper from the two indicated sections and install the insulating paper in the chassis.

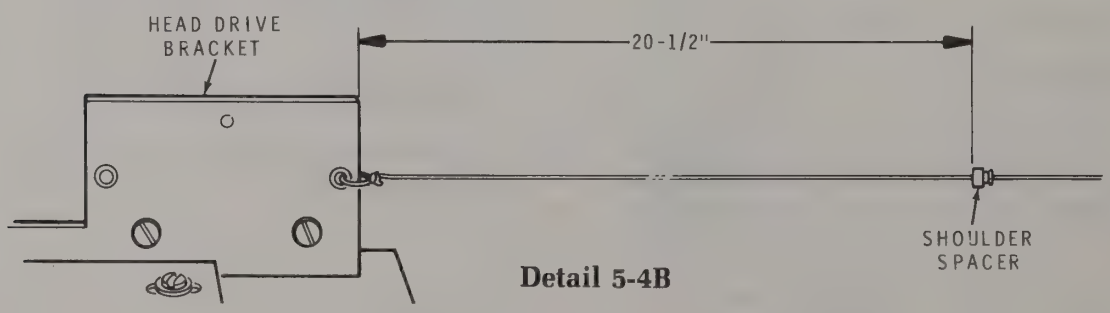
Refer to Pictorial 5-4 (Illustration Booklet, Page 16) for the following steps.

Turn the chassis over and position it as shown in the Pictorial.

() Refer to Detail 5-4A and insert one end of the print head string through the eyelet. Then insert both ends of the string through the 3/32" shoulder spacer.

NOTE: Refer to the Pictorial and read through the following seven steps to become familiar with the procedure for installing the string. Then go back and perform each step.

() 1. Move the print head to the extreme right of the platen.



Detail 5-4B

() 2. Refer to Detail 5-4B and tie one end of the string to the eyelet on the right side of the head drive bracket. Then measure 20-1/2" from the bracket move the shoulder spacer to this point, and press the eyelet into the spacer to hold the spacer in place.

() 3. Route the string around pulley CC and insert the assembled spacer and eyelet into the hole in the head drive pulley, making sure the free end of the string exits from the right side of the hole.

() 4. Hold the spacer in the hole and turn the head drive pulley counterclockwise and wind the string onto the grooves of the pulley. Make sure the string starts in the groove located nearest to the center of the hole.

() 5. Route the free end of the string around the nylon pulley at CD on the chassis and insert it through the left eyelet on the head drive bracket.

() 6. Hold the string against the head drive bracket above the threaded hole, place the retaining clip on the head drive bracket as shown in the inset drawing to hold the string.

() 7. Secure the retaining clip with a 4-40 × 1/4" screw. Pull the string taut before you tighten the screw and then cut off the excess string.

Refer to Pictorial 5-5 (Illustration Booklet, Page 16) for the following steps.

() Insert the left end of the assembled paper drive shaft through the nylon bearing on the left paper drive bracket, making sure the notch in the left paper hold-down bracket is positioned on the support shaft.

() Continue inserting the paper drive shaft through the nylon bearing until the right end of the shaft clears the right paper drive bracket.

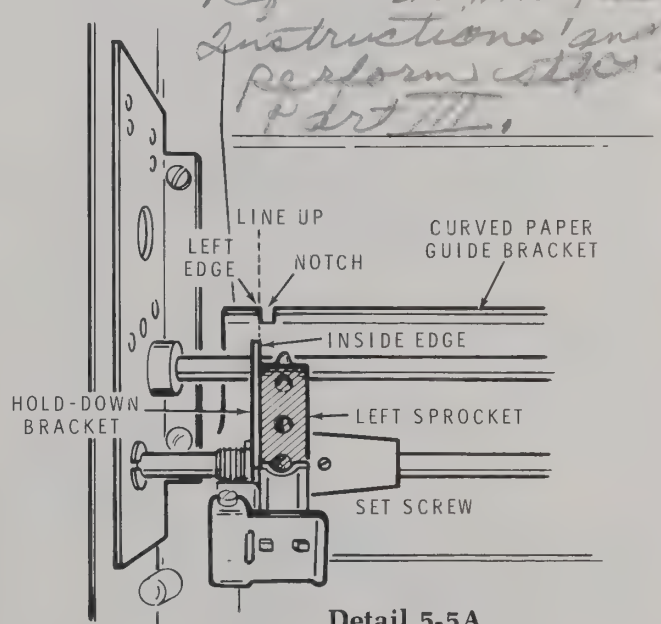
() Position the notch of the right hold-down bracket on the support shaft, and insert the right end of the paper drive shaft through the nylon bearing on the right paper drive bracket. Make sure the spur gear meshes with the gear teeth on the shaft of the paper drive motor.

() To obtain the proper amount of backlash (free play) in the gears, loosen the motor mounting spacers just slightly (if necessary) and slide the motor. Turn the sprockets to several different positions, and make sure there is a small amount of backlash at each position. Then tighten the motor mounting spacers and the circuit board mounting screws.

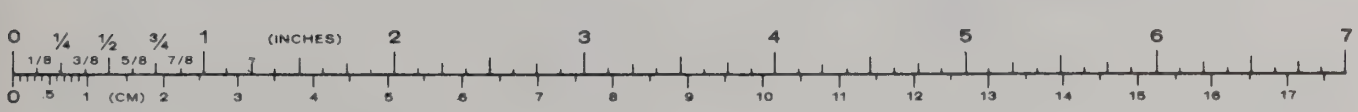
() Move the paper drive shaft to the right until the hub of the gear just touches the nylon bearing. At the other end of the shaft, move the small shaft collar until it just touches the nylon bearing, then tighten the setscrew.

() Refer to Detail 5-5A and loosen the setscrew on the left sprocket. Then move the sprocket assembly until the inside edge of the hold-down bracket that engages the support shaft lines up with the left edge of the 1/8" wide notch near the left end of the curved paper guide bracket. Also, carefully align a tooth in the left sprocket with a tooth in the right sprocket. Then tighten the setscrew.

Refer to the Modification Instructions and perform step 2 of Part III.



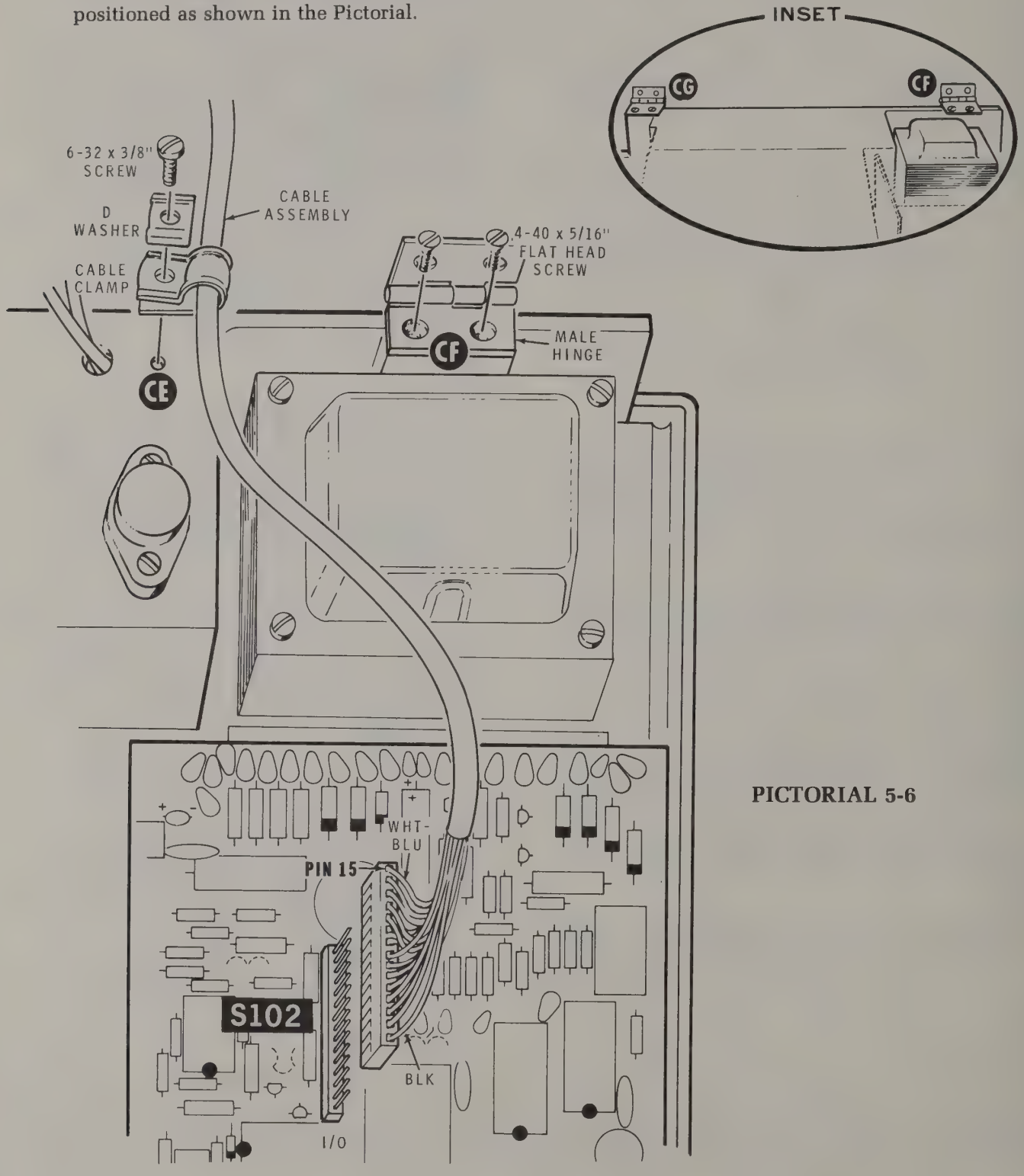
Detail 5-5A



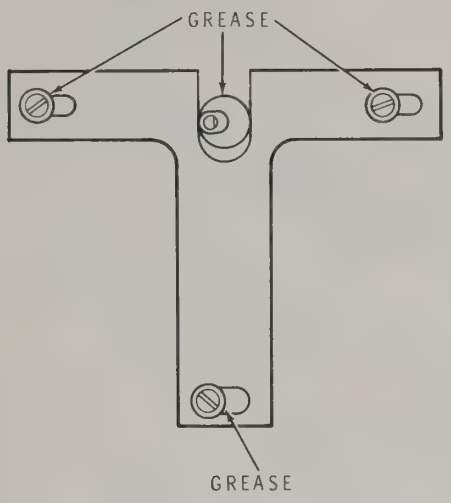
Refer to Pictorial 5-6 for the following steps.

() Place the large cable clamp on the cable assembly 7-1/2" from the connector. Mount the cable clamp to the chassis at CE with a D-washer and a 6-32 × 3/8" screw. Be sure the cable clamp is positioned as shown in the Pictorial.

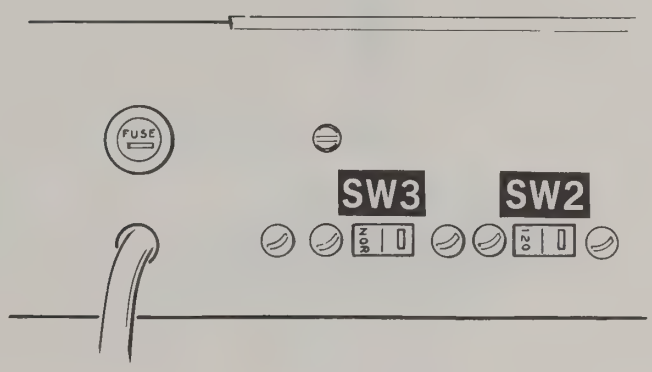
NOTE: In the following step, be sure that the cable connector mates properly with circuit board connector I/O S102. Position the connector with the black and white-blue wires as shown.



PICTORIAL 5-6



PICTORIAL 5-7



Detail 5-8A

() Connect the cable assembly to the circuit board connector I/O S102.

() Mount the hinges with two 4-40 × 5/16" flat head screws on each hinge to the top rear of the chassis at CF, and CG as shown in the inset drawing.

CAUTION: In the following step, be sure to use the correct grease (not thermal compound). The part number (#352-14) is stamped on the bottom of the container.

() Refer to Pictorial 5-7 and apply a liberal coating of grease to the three brass shouldered spacers and the ribbon motor cam. Rotate the ribbon motor cam by hand to be sure the grease is distributed evenly. (Do **not** use the thermal compound, #352-31.)

Refer to Pictorial 5-8 (Illustration Booklet, Page 17) for the following steps.

() Remove the two protective strips from the caution label and mount the label to the chassis in the area shown in the Pictorial.

() Remove the protective backing from the blue and white model label and mount the label to the chassis in the area shown in the Pictorial.

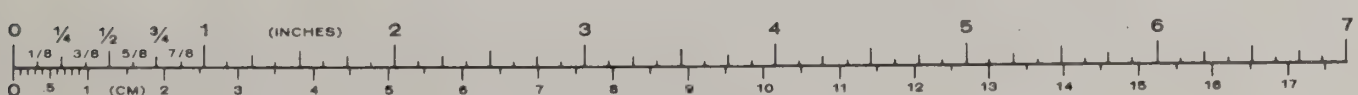
Refer to Detail 5-8A for the next two steps.

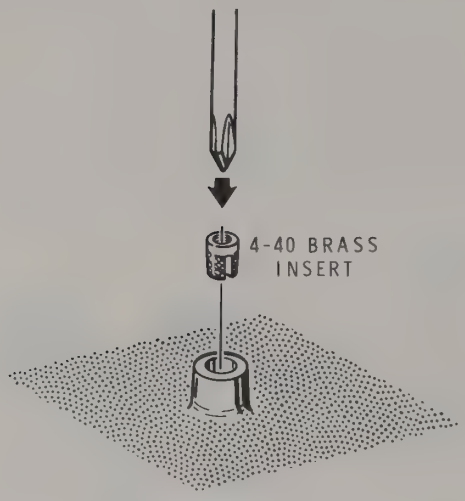
() Set the 120/240 switch (SW2) to the position corresponding to the power line voltage in your area.

() Measure the power line voltage with a voltmeter. If the voltage is 110 VAC or more (or 220 VAC for 240-volt operation), set the NOR/LOW switch (SW3) to the NOR position. If the voltage is less than 110 VAC (or 220 VAC for 240-volt operation), set the NOR/LOW switch to the LOW position. NOTE: If no meter is available, set the switch to the NOR position.

() If the power line voltage in your area is 120 VAC, install the 1-ampere slow-blow fuse in the fuseholder. If the power line voltage is 240 VAC, install the 1/2-ampere slow-blow fuse.

() Refer to the inset drawing in Pictorial 5-8 and, if your power line frequency is 60 Hz, set switch SW102 section 2 to "1." If your power line frequency is 50 Hz, set it to "0."



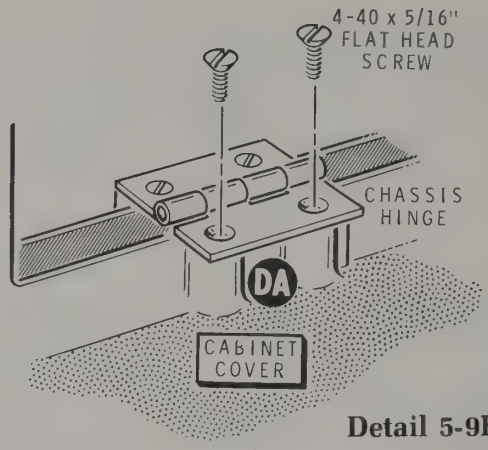


Detail 5-9A

Refer to Pictorial 5-9 (Illustration Booklet, Page 18) for the following steps.

() Position the cabinet cover on your work area as shown.

() Refer to Detail 5-9A and install the eleven 4-40 brass inserts in holes DA through DJ by pushing down on them with a phillips screwdriver or similar tool. Press the inserts down until they are flush with the top of the bosses.

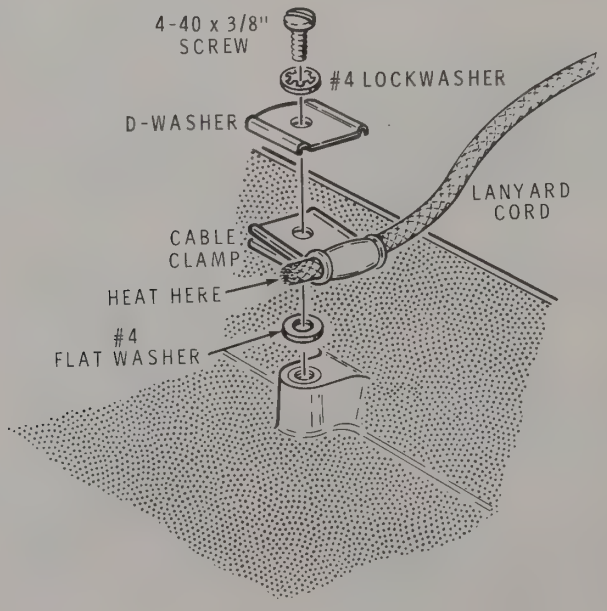


Detail 5-9B

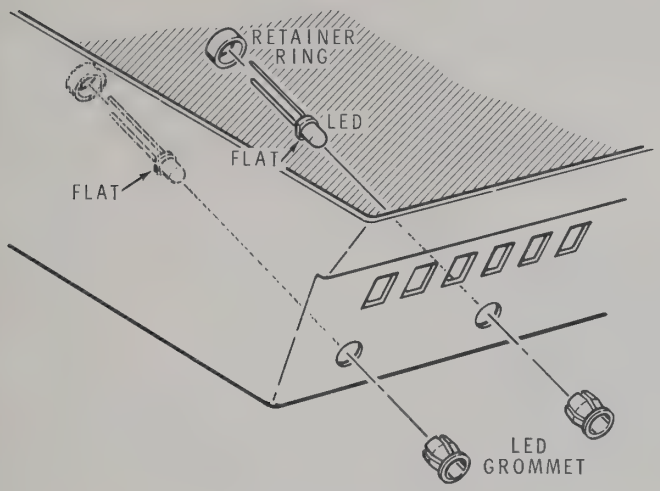
() Secure the chassis hinges to the cabinet cover at DA and DD with two 4-40 × 5/16″ flat head screws on each hinge as shown in Detail 5-9B. Be sure the large black wires are inside the chassis before you install the screws.

() Refer to Detail 5-9C and install the small cable clamp on one end of the lanyard cord. Mount the cable clamp at DE with a #4 flat washer, a D-washer, a #4 lockwasher, and a 4-40 × 3/8″ screw.

() Heat the end of the lanyard cord as shown in Detail 5-9C for a few seconds with your soldering iron to form a slight ball at the end. This will keep the cord from coming apart.



Detail 5-9C



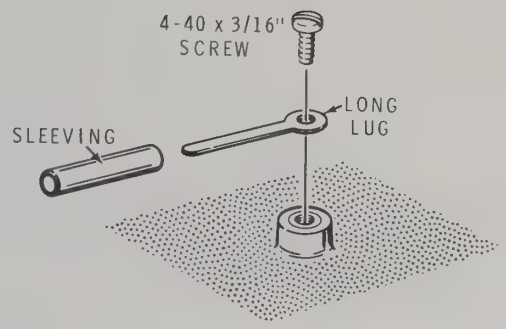
Detail 5-9D

Refer to Detail 5-9D for the next three steps:

() 1. Install the two LED grommets in the holes on the front of the cabinet cover.

() 2. LED1 and LED2: Insert the LED's into the LED grommets from the inside of the cabinet cover; be sure the flat side of each LED is positioned as shown and push the LED's into the grommets as far as possible.

() 3. Mount the retainer rings over the LED's and onto the LED grommets.

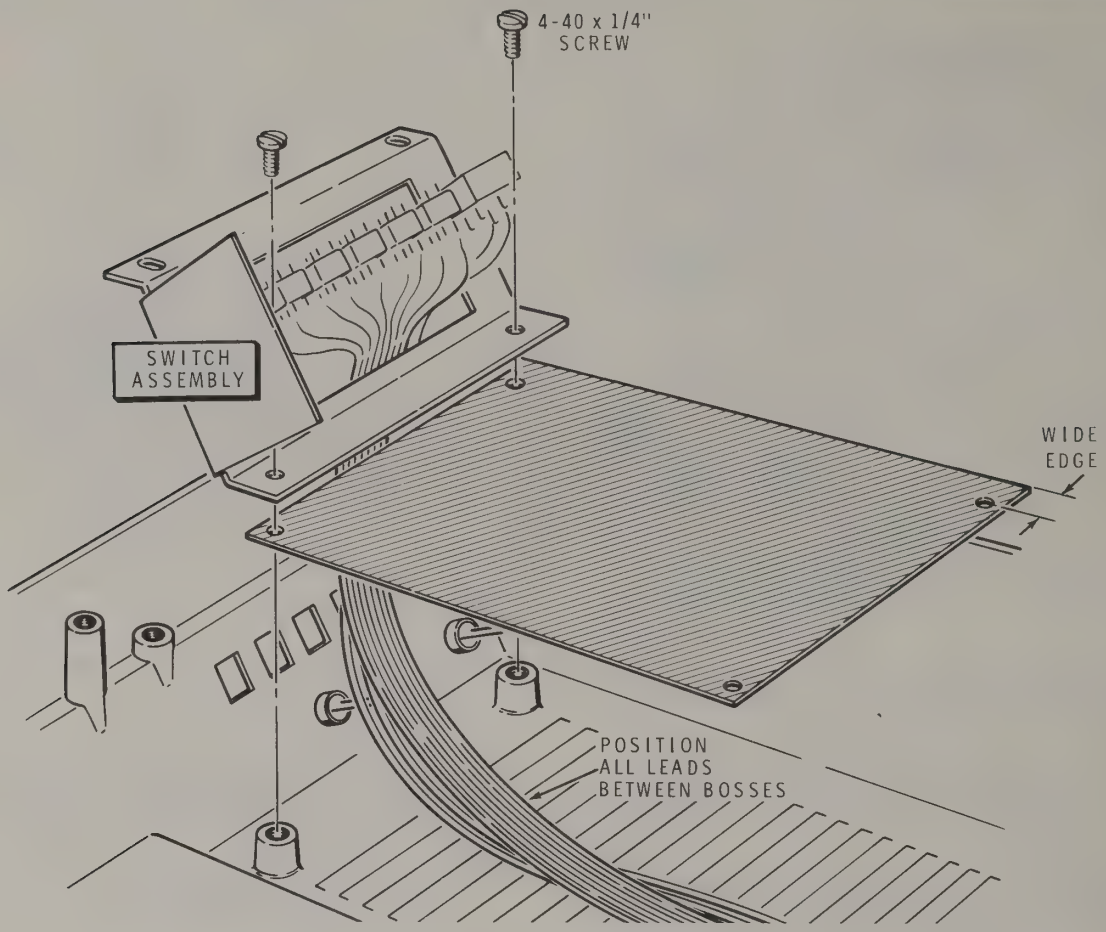


Detail 5-9E

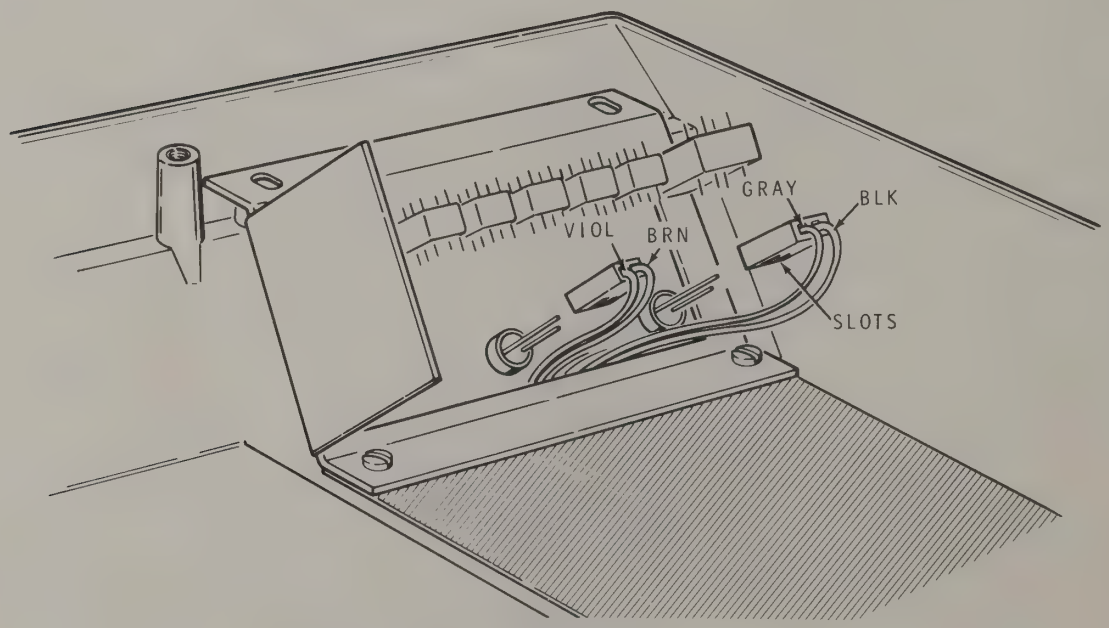
Refer to Detail 5-9E for the next two steps:

() Mount the two long lugs at DB and DC with a 4-40 × 3/16" screw at each lug. Be sure the lugs are positioned as shown in the Pictorial.

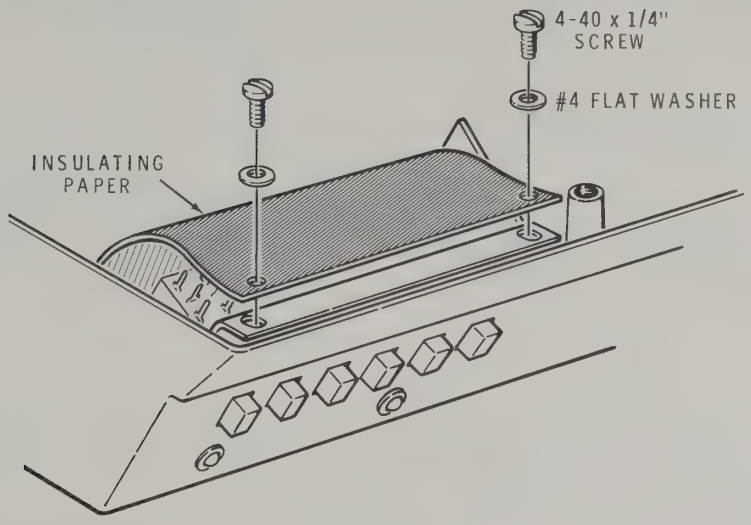
() Cut the large sleeving in half and place each piece on the long lugs.



Detail 5-9F



Detail 5-9G



Detail 5-9H

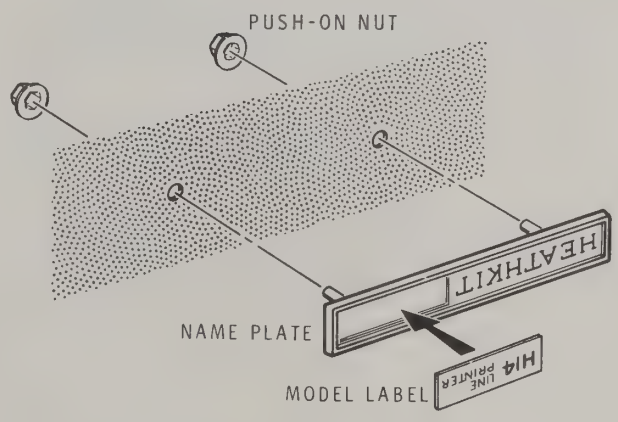
() Refer to Detail 5-9F and mount the switch assembly and the insulating paper to the cover with two 4-40 × 1/4" screws at DF and DJ. Position the insulating paper with the wide edge as shown. Be sure the leads are positioned as shown in the Detail.

() Refer to Detail 5-9G and connect the two connectors from the switch assembly to LED1 and LED2. Refer to the wire colors called out in the Detail, and be sure the connectors are connected as shown.

() Refer to Detail 5-9H and bend the insulating paper over the switch assembly as shown. Secure the insulating paper and the switch assembly to the cover with two 4-40 × 1/4" screws and #4 flat washers at DG and DH as shown in the Pictorial.

() Tie the three black wires to the ribbon cable using the remaining two cable ties; space the ties evenly along the length of the wires between the switch assembly and the long lug. Cut the excess cable tie lengths after the cable ties are installed.

() Refer to Detail 5-9J and remove the protective backing from the orange model identification label. Install the label on the nameplate and then mount the nameplate to the cover with two push-on nuts as shown. Turn the nuts as you push on them to make them easier to install.



Detail 5-9J

() Remove the protective backing from the set-up instruction label and mount the label on the inside of the cabinet cover in the area shown in the Pictorial.

Refer to Pictorial 5-10 (Illustration Booklet, Page 19) for the following steps.

() Bend the long lugs under and around the switch assembly wires to hold the wires in place.

() Refer to inset drawing #2 on the Pictorial and route the cord through the plastic grommet at DK on the left paper guide bracket. Arrange the cord in the groove of a D-washer and mount the D-washer with a 6-32 × 1/4" screw.

() Close the cabinet cover.

This completes the "Step-by-Step Assembly" of your kit. Proceed to "Initial Tests."

INITIAL TESTS

Refer to Pictorial 6-1 (Illustration Booklet, Page 20) for the following steps.

If you have an ohmmeter, complete the following resistance tests.

NOTE: If you do not obtain the indicated resistance readings in the following steps, check the associated parts for solder bridges, parts installed incorrectly, or incorrect wiring. Also, try reversing the meter leads.

() Press the POWER switch to the off (out) position.

() Prepare a 5″ small solid black hookup wire and insert one end into the pin connector at J112.

() Connect the common lead of the ohmmeter to the free end of the 5″ hookup wire. NOTE: Leave the lead connected to the hookup wire for the following steps.

() Connect the ohmmeter test lead to either lead of resistor R169 (.33 Ω, orange-orange-silver). The ohmmeter should increase to greater than 1000 ohms.

() Connect the ohmmeter test lead to the lead on the banded end of diode D123. The ohmmeter should read greater than 400 ohms.

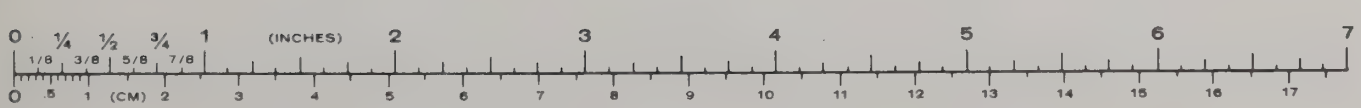
() Connect the ohmmeter test lead to the lead on the **non-banded** end of diode D124. The ohmmeter should read greater than 400 ohms.

() Connect the ohmmeter lead to the round prong on the line cord plug. The ohmmeter should read 0 (zero) ohms.

() Connect the common ohmmeter lead to the round prong on the power plug. Push the POWER switch to the on (in) position; then alternately connect the ohmmeter test lead to each flat prong on the power plug. The ohmmeter should read ∞ (infinity) for both tests.

() Push the Power switch to off.

This completes the resistance test, disconnect the ohmmeter from the power plug.



() Check to make sure the print head plug is not plugged into socket S101.

NOTE: In the following step, you will turn the Printer on and check for overheating of parts. If there is evidence of overheating, disconnect the power plug immediately and check for short circuits in the circuitry where the overheating occurred.

WARNING: When the line cord is plugged in, the full AC line voltage is present at the POWER switch.

() Plug the line cord into an AC outlet and push the POWER switch to the ON position. The POWER indicator should light and the HIGH TEMP light may or may not light.

If you have a voltmeter, complete the three following voltage tests.

() Connect the meter common lead to the 5" hookup wire. Leave the lead connected to the 5" hookup wire for the three following voltage tests.

() Connect the voltmeter test lead to either lead of resistor R169 (.33 Ω, orange-orange-silver). The meter should read between 45 to 60 volts DC. If not, check D118, D119, D121, D122, C3, and the wiring of transformer T1.

() Connect the voltmeter test lead to either clip of fuse F101. The voltmeter should read between 32 to 38 volts DC. If not, check Q1, Q124, Q125, Q126, D127, and U101 (5-volt supply).

() Connect the voltmeter test lead to pin 40 of U106. The voltmeter should read between 4.7 to 5.3 volts DC. If not, check C2, D123, D125 (12-volt supply), U101, and C115.

This completes the voltage tests. Disconnect the voltmeter.

() If not already done, push the print head to the left side of the unit.

() Momentarily connect the free end of the 5" hookup wire to pin 31 of U106. The print head should move from left to right. If not, check U115D, D118, D112, C5, T1, and the head motor.

() Momentarily connect the free end of the 5" hookup wire to pin 32 of U106. The print head should move from right to left. If not, check U115A, Q117, D111, C5, and the head motor.

() Momentarily connect the free end of the 5" hookup wire to pin 33 of U106. The ribbon motor should run. If not, check U115B, Q119, D113, T1, and the ribbon motor.

() Prepare an 11" hookup wire and insert one end into the pin connector at TP-101.

() Momentarily touch the free end of the 11" hookup wire to each of the metal tabs of Q201, Q202, Q203, Q204. As you touch each tab LED101 should not glow.

() Connect the free end of the 5" hookup wire coming from J112 to pin 29 of U106; then connect the free end of the 11" hookup wire to the collector (C) lead of Q203. LED101 should light. If it does not, check U115F and Q203.

() Connect the 5" hookup wire to pin 28 of U106; then connect the 11" hookup wire to the collector (C) lead of Q201. LED101 should light. If it does not, check U116F and Q201.

() Connect the 5" hookup wire to pin 27 of U106; then connect the 11" hookup wire to the collector (C) lead of Q202. LED101 should light. If it does not, check U116A and Q202.

() Connect the 5″ hookup wire to pin 26 of U106; then connect the 11″ hookup wire to the collector (C) lead of Q204. LED101 should light. If it does not, check U116B and Q204.

NOTE: Control R195 (HIGH TEMP ADJ control) should not be installed on the circuit board yet.

() Connect the free end of the 11″ hookup wire to pin 9 of print head socket S101. LED101 should not light. Then, with the 11″ hookup wire still connected, connect the free end of the 5″ hookup wire to pin 14 of U106. LED101 **should** light. If not, check U114D, Q103, andQ104.

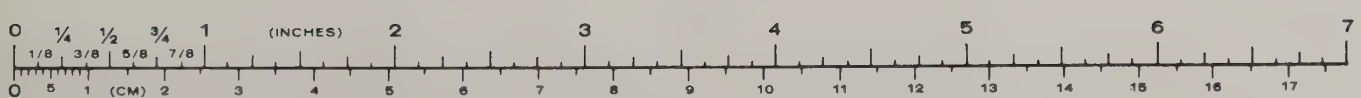
Using the procedure in the previous step, complete the steps in the chart at the bottom of this page.

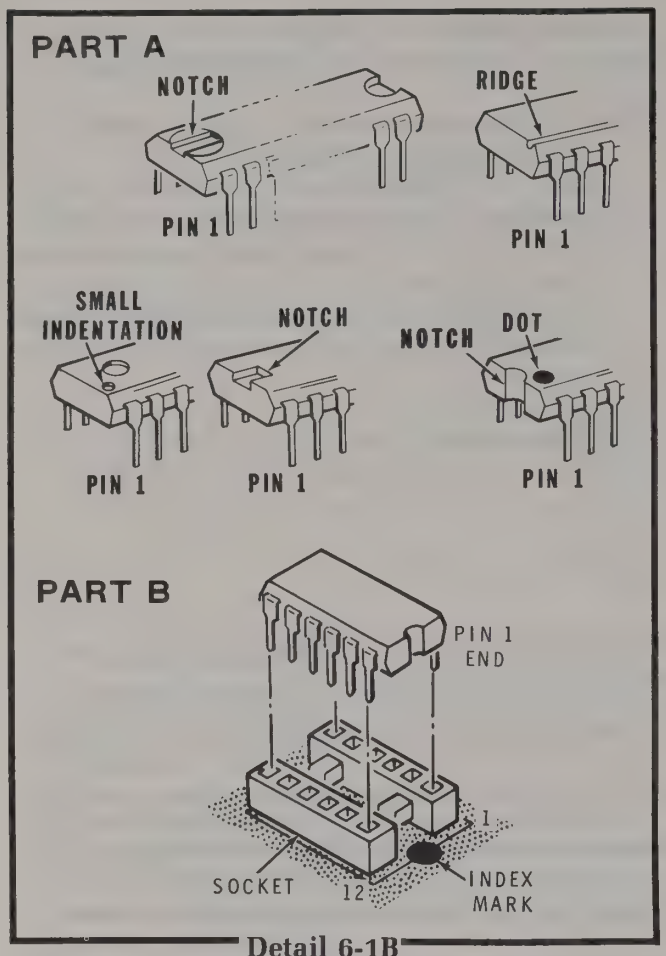
() Remove the 11″ hookup wire from TP101 and connect one end to TP102.

() Momentarily connect the free ends of the 5″ and 11″ hookup wires together and note the brightness of LED102. Now connect the 11″ hookup wire to pin 16 of U105. LED102 should glow at a reduced brightness. If not, check U107, U108, and Y101.

() Turn the power off.

	CONNECT 11″ WIRE TO S101 PIN (LED101 SHOULD NOT LIGHT)	THEN CONNECT 5″ WIRE TO U106 PIN (LED101 SHOULD LIGHT)	POSSIBLE CAUSE IF LED101 DOES NOT LIGHT
()	10	13	U114E, Q105, Q106
()	14	12	U114F, Q107, Q108
()	15	11	U114C, Q109, Q110
()	13	10	U114B, Q111, Q112
()	12	9	U114A, Q113, Q114
()	11	8	U115C, Q115, Q116





Detail 6-1B

NOTE: Refer to Detail 6-1B and, as you install each IC in the following steps, position the pin 1 end (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the IC leads into the socket and push the IC down into place.

() U109: Install a 74LS244N IC (#443-791) at U109.

() U110: Install a 74LS244N IC (#443-791) at U110.

() Turn the power on.

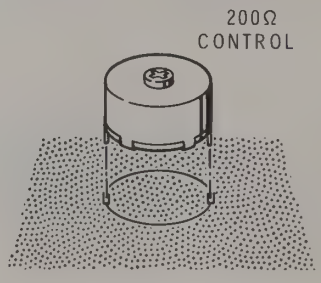
() Connect the 5″ hookup wire to pin 37 of U106, connect the 11″ hookup wire to pin 16 of U106, and manually push the print head to the left stop. LED102 should not light. Then move the print head at least 2″ to the right. LED102 should now light. If not check U109 and Q3.

() Connect the 11″ hookup wire to U106 pin 5 (with the 5″ hookup wire still connected to U106 pin 37). LED102 should light. Now insert a piece of paper, with the sprocket holes removed, into the paper feed channel. Push the paper as far to the left as possible. LED102 should now go off. If it does not, check LED3, Q2, and U109.

() With the 5″ hookup wire still connected to pin 37 of U106, connect the 11″ hookup wire to pin 17 of U106 and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not check U109 and SW4.

() Connect the 5″ hookup wire to pin 36 of U106, connect the 11″ hookup wire to pin 17 of U106, and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not, check U110 or SW4.

() With the 5″ hookup wire still connected to pin 36 of U106, connect the 11″ hookup wire to pin 19 of U106 and place section 4 of SW102 in the 1 position. LED102 should be off. Press TEST switch SW101; LED102 should light. If not, check U110, SW101, and SW102.



Detail 6-1C

() Press the POWER switch to the OFF position.

() R195: Refer to Detail 6-1C and install a 200 Ω control at R195 on the circuit board. Solder the tabs to the foil on the underside of the circuit board.

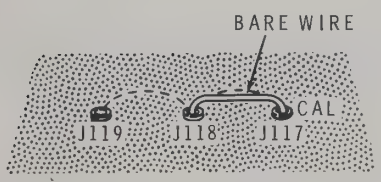
() Turn R195 fully counterclockwise (CCW).

Refer to Pictorial 6-2 (Illustration Booklet, Page 20) for the following two steps.

() Position the chassis on your work area as shown.

NOTE: In the following step, check the print head cable assembly connector for bent pins. If any pins are bent, straighten them using long-nose pliers.

() Route the print head cable assembly as shown in the Pictorial. Line up pin 1 of the cable assembly connector with the pin 1 mark on the circuit board and plug the connector into socket S101.



Detail 6-1D

() Refer to Detail 6-1D and be sure there is a wire between J118 and J117 on the circuit board.

() Press the POWER switch to the ON position. The HIGH TEMP indicator (LED2) on the front panel should be off. Slowly rotate R195 clockwise until the HIGH TEMP indicator lights.

() Press the POWER switch to the OFF position and reconnect the bare wire between J118 and J119.

() Press the POWER switch to the ON position. The HIGH TEMP indicator should not light. If it does light, check U117, U116D, and U116E.

() Connect the 5″ hookup wire to pin 37 of U106. Then alternately connect the 11″ hookup wire to pin 3 and pin 4 of U106. LED102 should not light for either of these tests.

() Unplug the print head plug and repeat the tests in the previous step. Now LED102 indicator should light for both tests. If not, check U109.

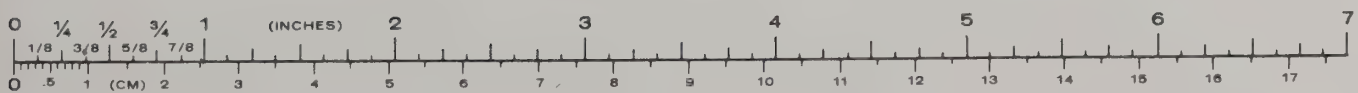
() Press the POWER switch to the OFF position.

() Plug the print head plug into socket S101.

() Remove the 5″ and 11″ hookup wires.

NOTE: The integrated circuits that you will install in the following steps are rugged and reliable components. However, normal static electrical discharge from your body, through an integrated circuit pin, to an object can damage the integrated circuits. Therefore when you install these integrated circuits, use the following numbered procedure. Perform each step carefully without interruption.

1. Remove the IC from the conductive foam.
2. Hold the IC in one hand and straighten any bent pins with the other hand.
3. Continue holding the IC, being careful not to touch it to anything while you touch the circuit board with your other hand.
4. Install the IC in its socket. See Pictorial 6-1 and Detail 6-1B.



() U103: Install a 1489 IC (#443-795) at U103.

() U104: Install a 75188N IC (#443-794) at U104

() U105: Install an 8250 IC (#443-874) at U105.

() U106: Install a 3870 IC (#444-31) at U106.

() U111: Install a 74LS273 IC (#443-805) at U111.

() U112: Install a 2112-2 IC (#443-721) at U112.

() U113: Install a 2112-2 IC (#443-721) at U113.

() Set the top panel switches as follows:

POWER	OFF (out)
ON LINE	OFF (out)
WIDE CHAR	WIDE (out)

() Refer to the Operation Manual (Pages 10, 11, and 12) and install the paper and ribbon in your Printer.

() Set all the sections of SW102 to "1," except for section 2, it should have been set to match your power line earlier. Refer to the inset drawing in Pictorial 5-8.

() Press the POWER switch to the ON position. The print head should move from left to right for a short period of time; then it should return to the left margin and stop. If not, check U106.

() Press the TEST switch (SW101) momentarily. A line of test information should be printed. If not, check U106.

NOTE: If the paper feeds crooked (in the next step) press the POWER switch to OFF. Loosen the set screw in the left sprocket and turn the sprocket to straighten the paper. Retighten the set screw. Turn the power back on and repeat the step to see that the paper feeds straight.

() Momentarily press the FEED FWD switch. The paper should move forward approximately .02 inches (one step). Then hold the FEED FWD switch down. The paper should continue to advance in full-line steps after a short delay. If not, check U109, U106, and SW6.

() Press the FEED REV switch. The paper should move back in the same mode as it moved forward. If not, check U106, U109, and SW7.

() Momentarily press the TOP FORM switch. The paper should advance 11". If not, check SW7, U110, and U106.

() Press the POWER switch to the OFF position.

This completes the "Initial Tests." Proceed to "Final Assembly."

FINAL ASSEMBLY

Refer to Pictorial 7-1 (Illustration Booklet, Page 21) for the following steps.

() Remove the protective backing from the small sheet of insulating paper. Refer to Detail 7-1A (Illustration Booklet, Page 21) and mount the insulating paper on the bright (unpainted) side of the bottom plate in the area shown in the Detail.

() Mount the four mounting feet on the painted side of the bottom plate with an 8-32 × 5/8" screw, #8 lockwasher, and an 8-32 nut on each foot at the locations shown in the Pictorial.

() Turn the chassis over on its top and place the bottom plate on the chassis as shown with the rectangular cut-out over the print head. Secure the bottom plate to the chassis with eight 6-32 × 1/4" black screws.

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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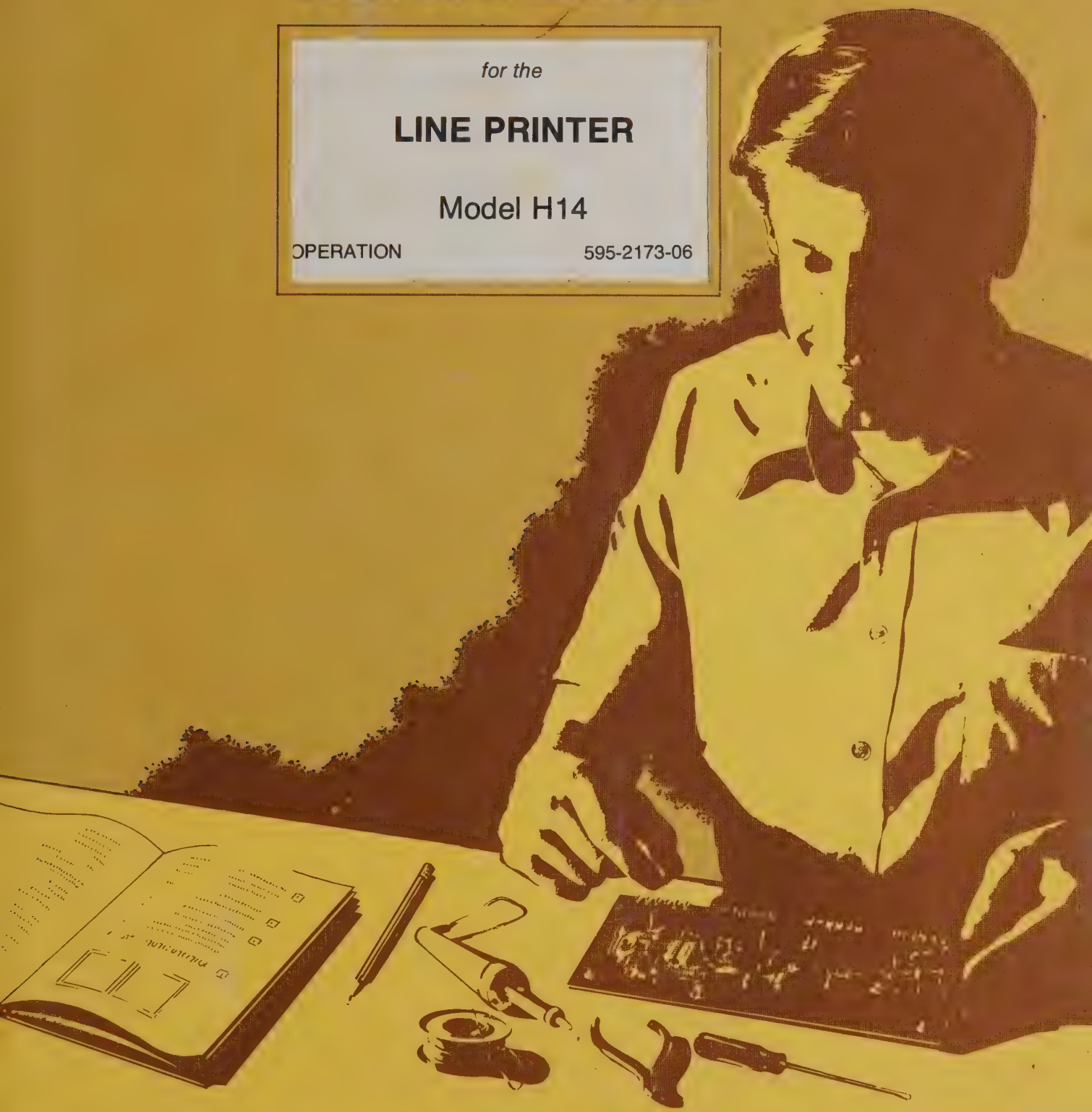
HEATHKIT® MANUAL

for the

LINE PRINTER

Model H14

OPERATION 595-2173-06



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and Home Clocks (616) 982-3315
Television (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products (616) 982-3496
Computers (616) 982-3309



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

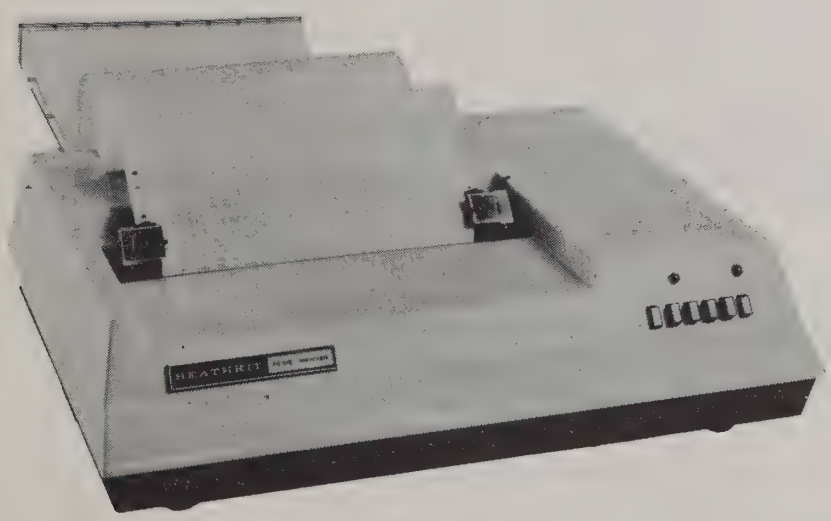
Heathkit® Manual

for the

LINE PRINTER

Model H14

OPERATION 595-2173-06



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heath Model H14 Line Printer is a computer peripheral that provides computer readouts in hard copy form. The Printer uses an inked ribbon and an impact-type printer to print a dot matrix on regular paper. The following features make the Printer very versatile:

- Both upper and lower case characters.
- Full 96-character ASCII font.
- Sprocket paper feed with adjustable spacing.
- Paper out and jammed detectors that prevent damage, or loss of data, or both.
- Microprocessor controlled functions and timing.
- Either RS-232C or 20 mA current loop serial interface (user selectable).
- Handshake control signals.
- Electronic form controls.

The modern design assures excellent reliability, and the handsome styling complements the Heath Computer Series.

For system configuration
(how to connect your Printer to your Computer)
information, see Page 6.

SPECIFICATIONS

PRINTOUT

Character Set	96 character ASCII, upper and lower case.
Character Format	5 × 7 dot matrix.
Printing Method	Impact. Uses 0.5 inch wide nylon inked ribbon on 2 inch diameter spools.
Character Height	0.110 inches.
Line Spacing	6 lines per inch. 8 lines per inch selectable by software.
Character Spacing	10 characters/inch (80 columns). 12 characters/inch (96 columns). 16.5 characters/inch (132 columns). 10 and 16.5 characters/inch are both hardware and software selectable. 12 characters/inch is software selectable only.
Printing Speed	Initial time per full line is approximately 1.75 seconds on 60 Hz power line and 2.1 seconds on 50 Hz power line. Print head temperature is monitored after each line and then limited by slowing or stopping the printing. The maximum throughput is determined by print density and ambient temperature. The maximum instantaneous printing rate is 165 c.p.s.

PAPER

Paper Type	Edge-punched fanfolded forms, 3.0″ to 9.5″ wide and maximum thickness of 0.006″.
Paper Feed	Sprocket, with adjustable width.
Forms Control	11″ form is selected at power up. Any form depth from 0.021″ to 1365″ may be electronically selected.

INTERFACE

Electrical	Serial RS-232C or 20 mA current loop. Handshake control signals (reverse channel or busy signal).
Connector	25 pin male EIA connector on 6 foot cable.
Data Format	Asynchronous bit serial; 1 start, 8 data, 2 stop bits on 110 baud and 1 stop bit on all others.
Character Code	ASCII.
Line Buffering	256 Characters.
Baud Rates	110, 150, 300, 600, 1200, 2400, or 4800.

PHYSICAL

Overall Dimensions	18-1/3″ W × 14-1/3″ D × 4-4/5″ H (46.5 cm W × 36.3 cm D × 12.1 cm H) less paper tray.
Net Weight	25 lbs. (11.3 kgs.).
Ambient Temperature	10°C to 40°C.
Power Requirements	100-135 volts 50-60, or 200-270 volts 50-60 Hz, 100 watts maximum.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

SYSTEM CONFIGURATION

HEATH SYSTEM CONFIGURATION

Your Line Printer communicates with your computer through a serial I/O card and may be operated at either RS-232C signal levels (see Pictorial 2, Page 9) or at 20 mA current loop levels (see Page 7). The 25-pin "D" connector conforms to RS-232C standards and will mate with most equipment which conforms to this standard. Adaptor cables to convert from earlier Heath equipment connectors to the RS-232C connectors are available from the Heath Company.

Set the Line Printer baud rate (4800 is recommended). Then set the Line Printer and the computer I/O card (do not use the H8-5 Serial I/O card; the H8-4 Multiport Serial I/O card is recommended) for the same type signal levels (RS-232C or 20 mA current loop) as described in the following sections (RS-232C is recommended).

Refer to your serial interface manual for information on how to set baud rates, addressing, vector interrupts, and signal levels on the serial card. Refer to your Software Manual under "System Configuration" for information on where to set the serial and address (PORT) and vector interrupt to communicate with this Line Printer.

PRINTER BAUD RATE SELECTION

To select a desired baud rate, place sections 5, 6, and 7 of switch SW102 (located on the circuit board inside your Printer) in the proper positions as indicated below. The baud rate will be updated upon going from "off line" to "on line," or during power up.

BAUD RATE	SWITCH SECTION		
	5	6	7
110	1	1	1
150	0	1	1
300	1	0	1
600	0	0	1
1200	1	1	0
2400	0	1	0
4800	1	0	0
9600 (Do not use)	0	0	0

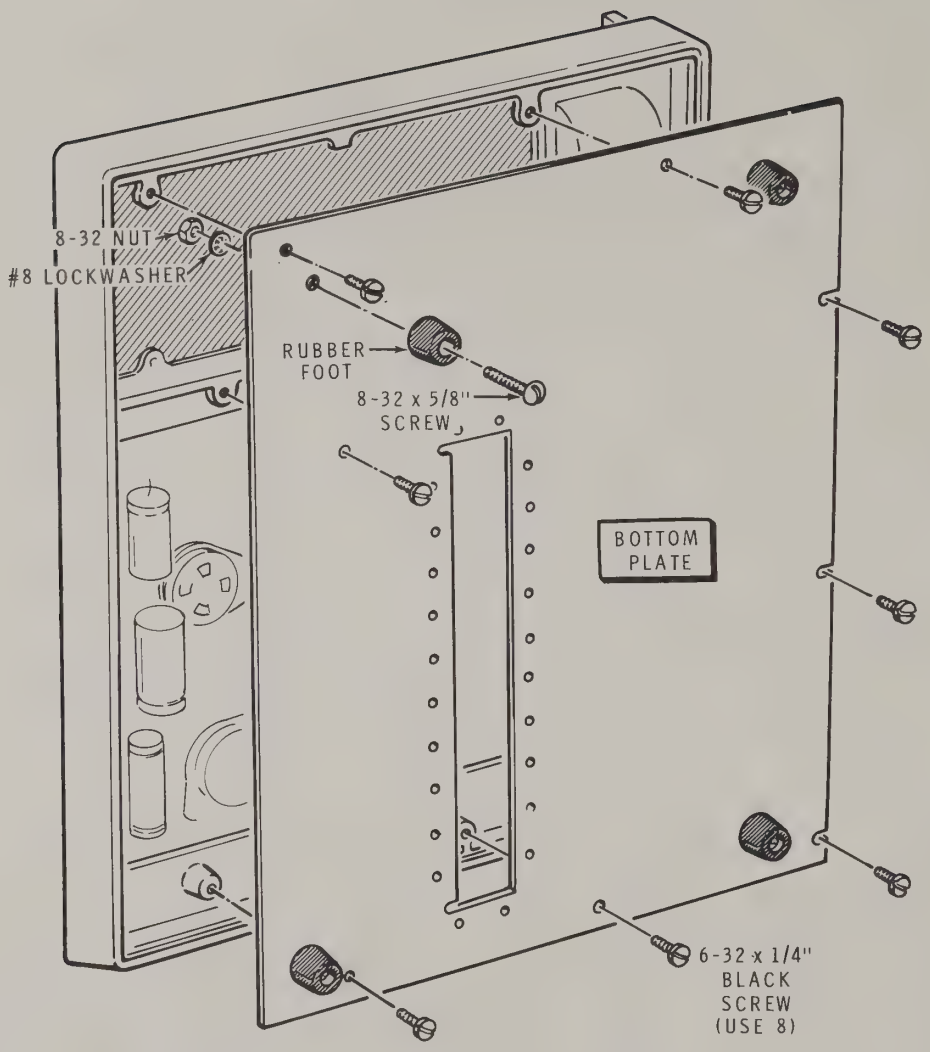
PRINTER SIGNAL LEVELS SELECTION

Wire your Printer for either RS-232C or 20 mA current loop operation as described below.

RS-232C Operation

To use the Printer on RS-232C operation, you must install jumper wires between circuit board holes J114 and J115, and J109 and J110.

Proceed to the "Operation" section.



PICTORIAL 7-1

SYSTEM CONFIGURATION

HEATH SYSTEM CONFIGURATION

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300	1	0	1
600	0	0	1
1200	1	1	0
2400	0	1	0
4800	1	0	0
9600 (Do not use)	0	0	0

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ILLUSTRATION BOOKLET

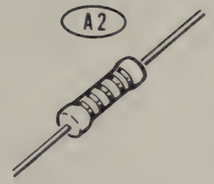
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MAIN CIRCUIT BOARD PARTS PICTORIAL

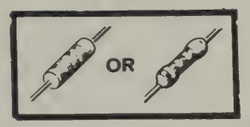
A1



A2



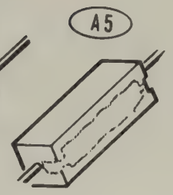
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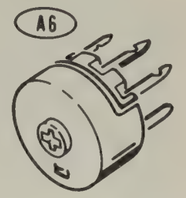
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A5



A6



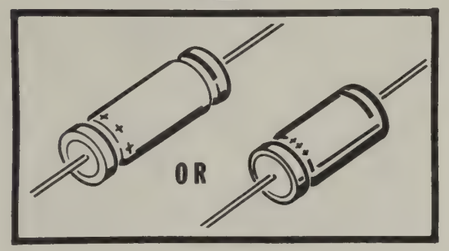
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B2



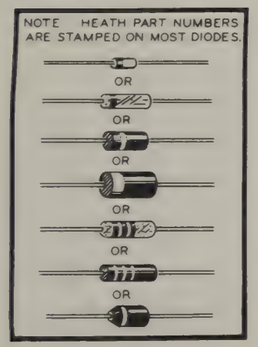
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B4



C1



C2



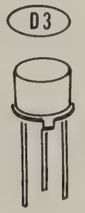
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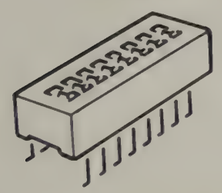
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D3



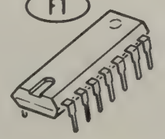
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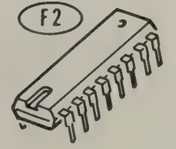
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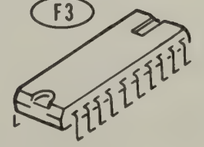
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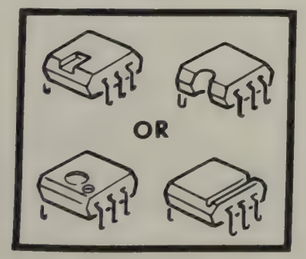
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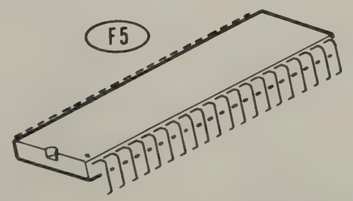
F3



F4



F5



G1

G2



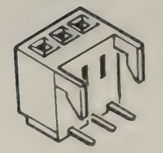
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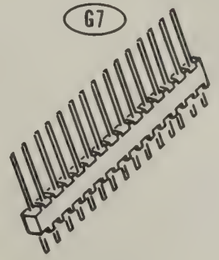
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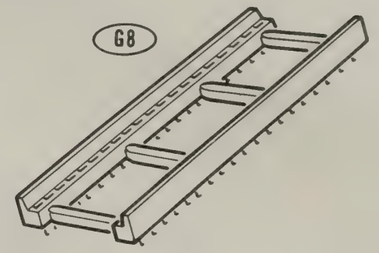
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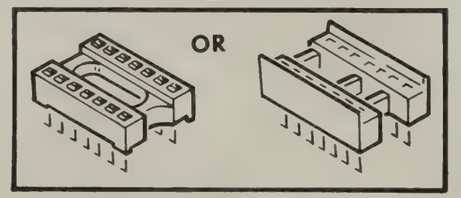
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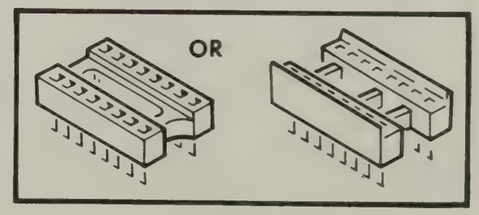
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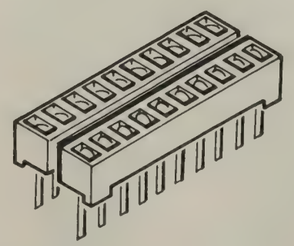
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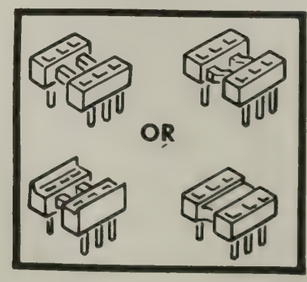
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G11



G12

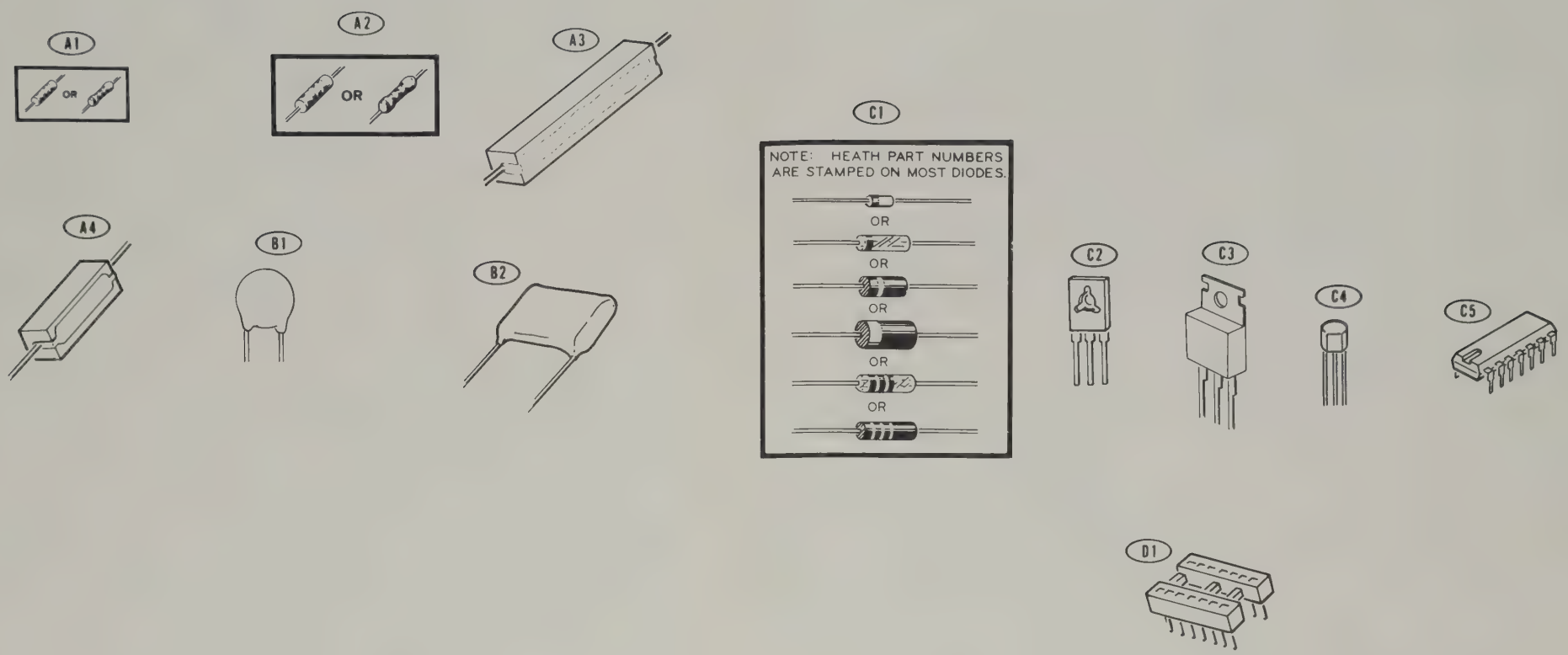


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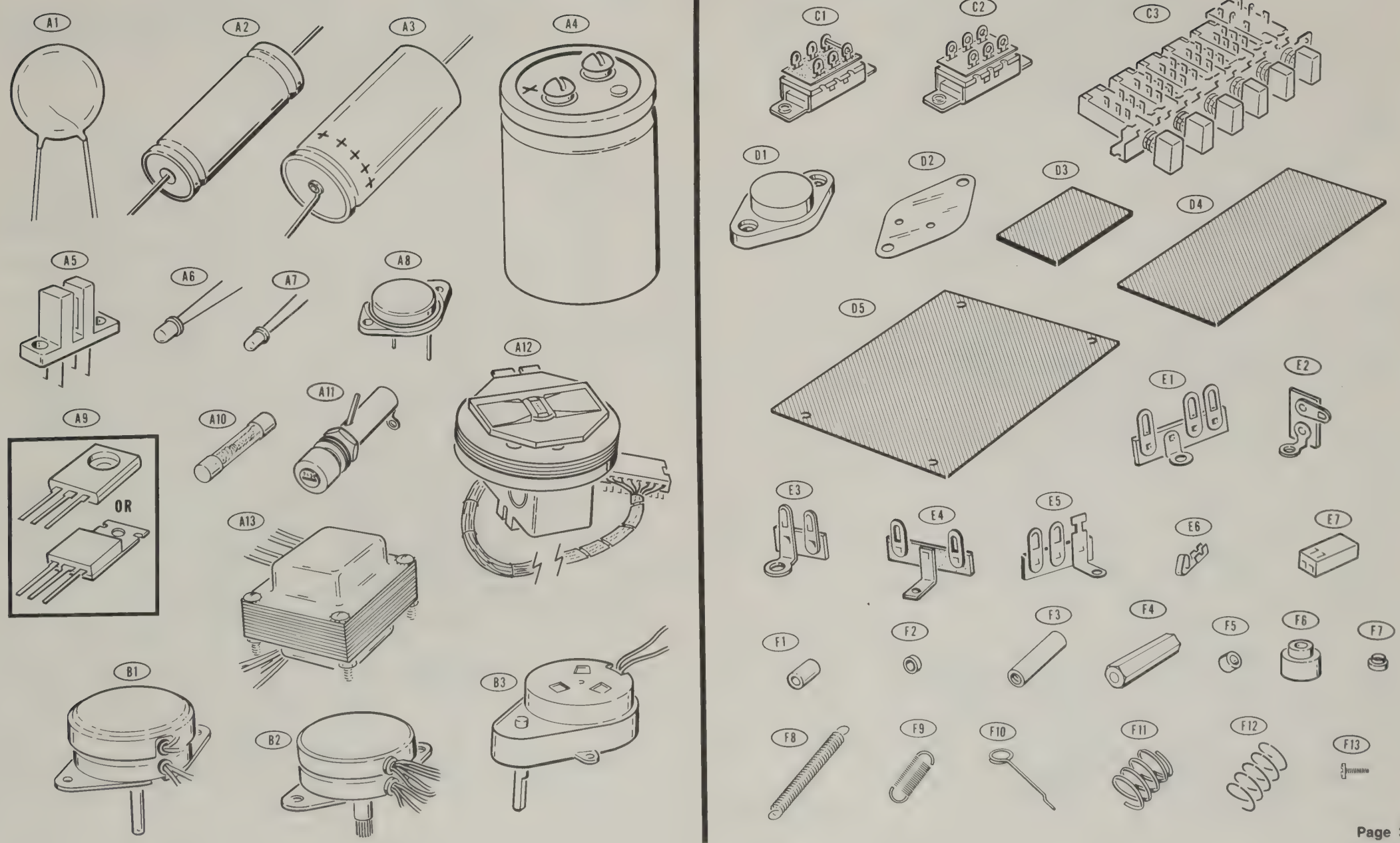


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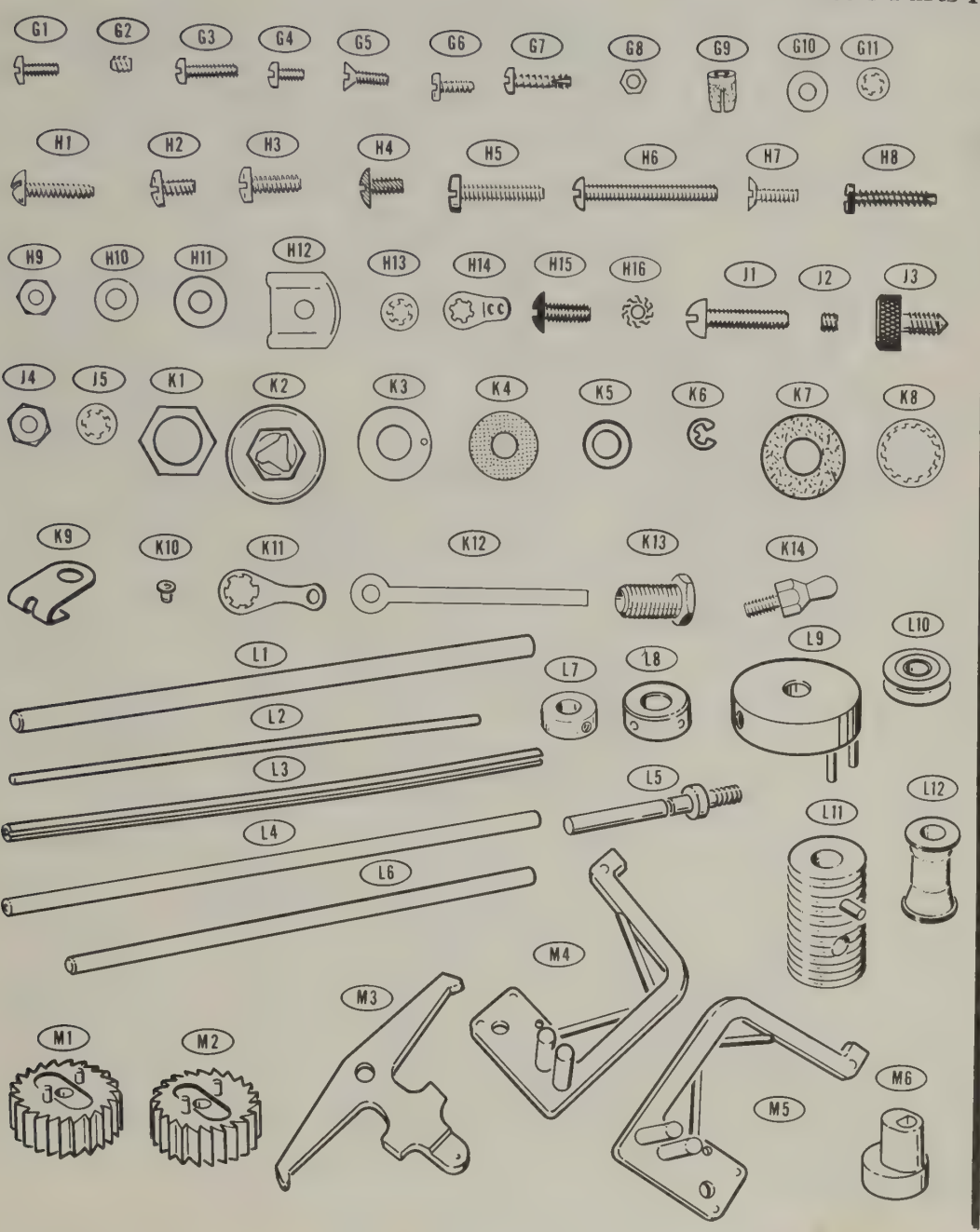
STEPPER DRIVER CIRCUIT BOARD PARTS PICTORIAL

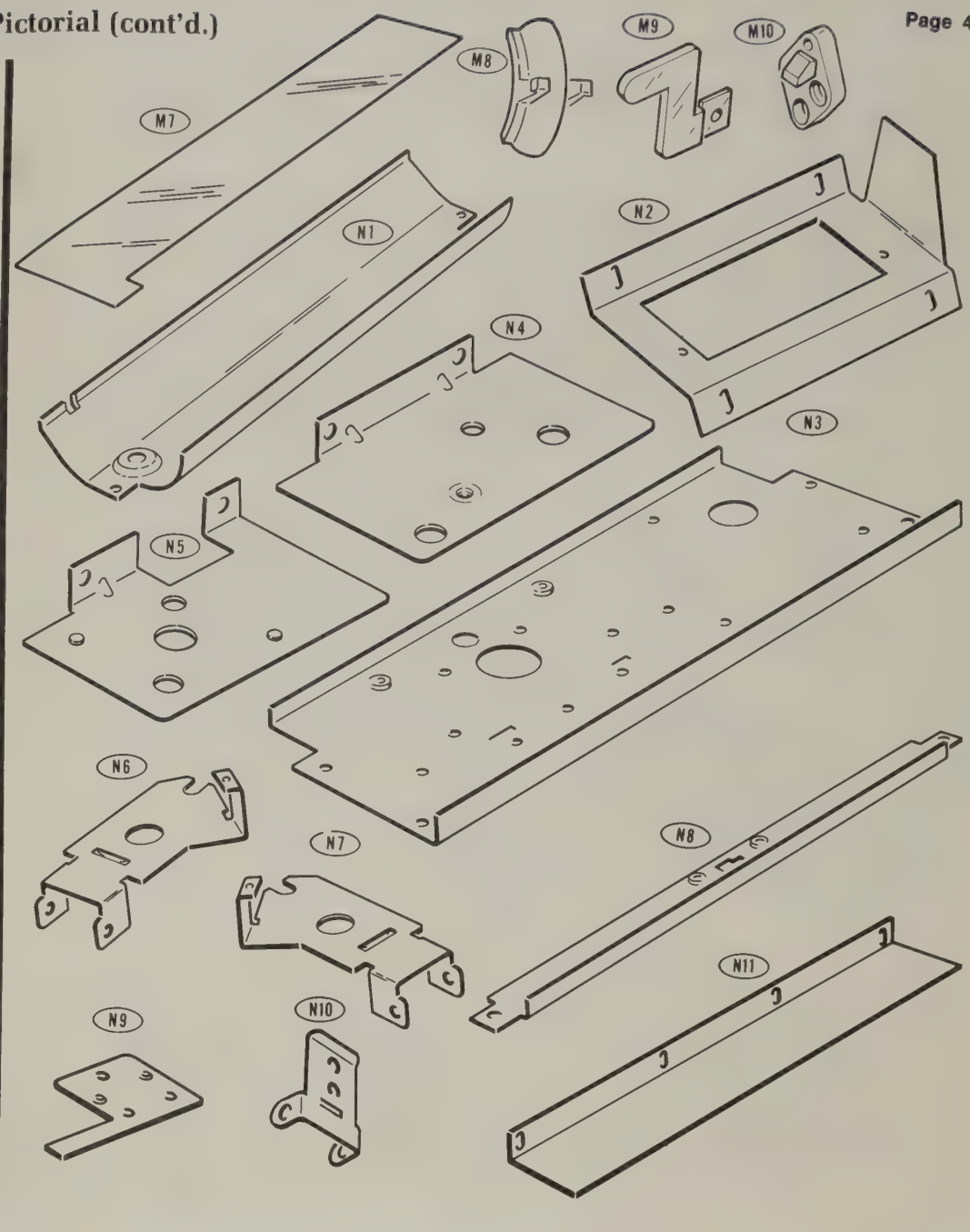


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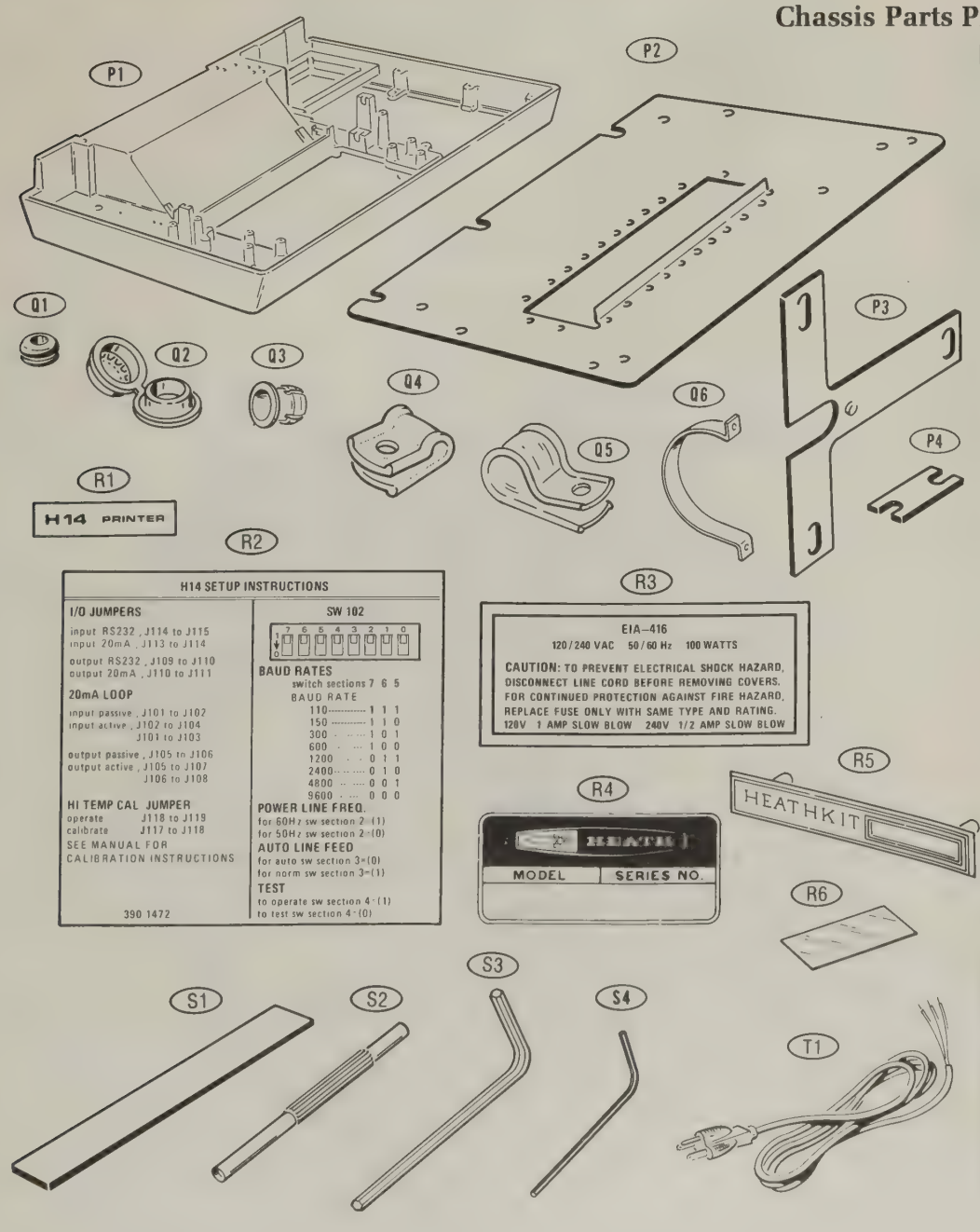


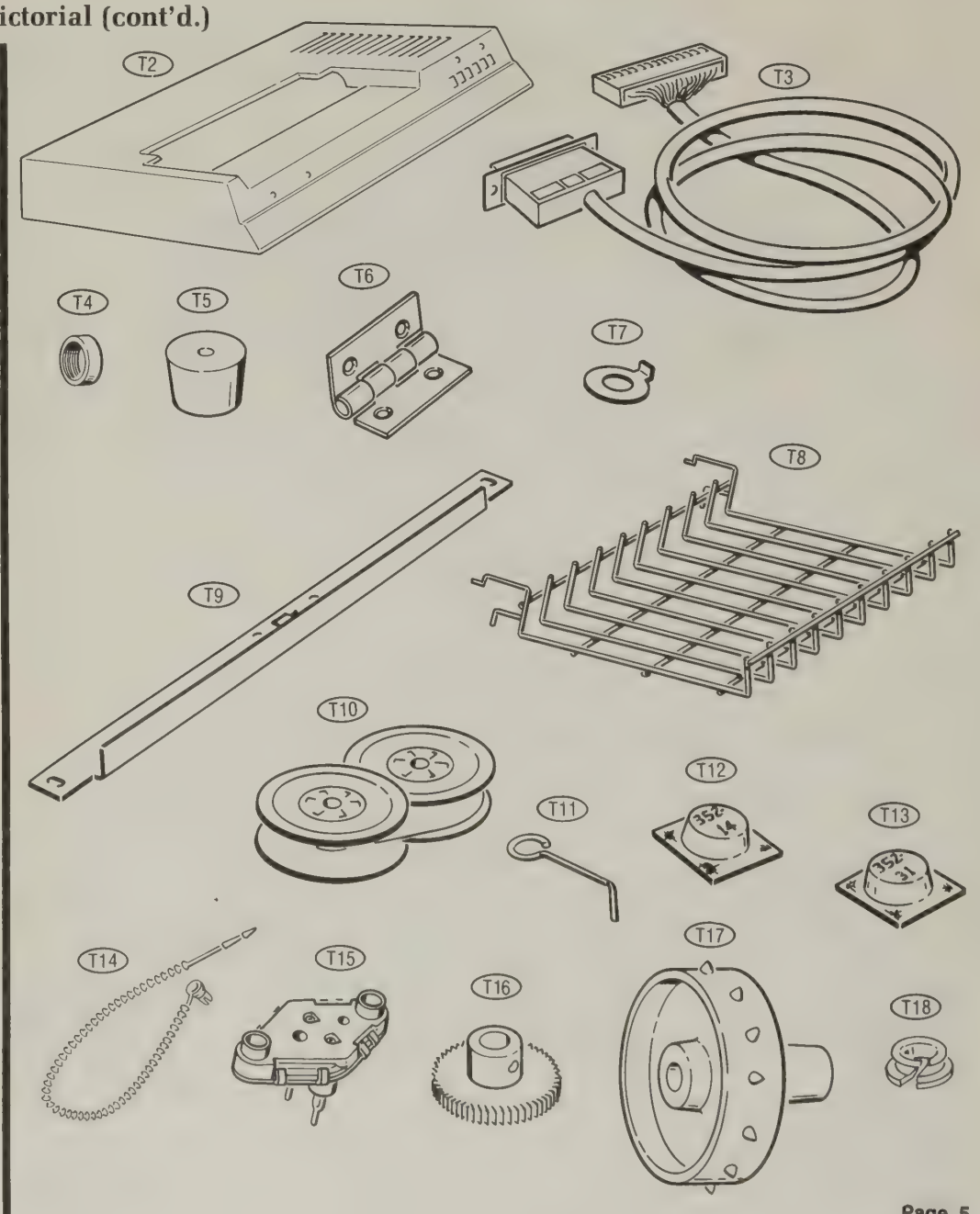
Chassis Parts Pictorial (cont'd.)

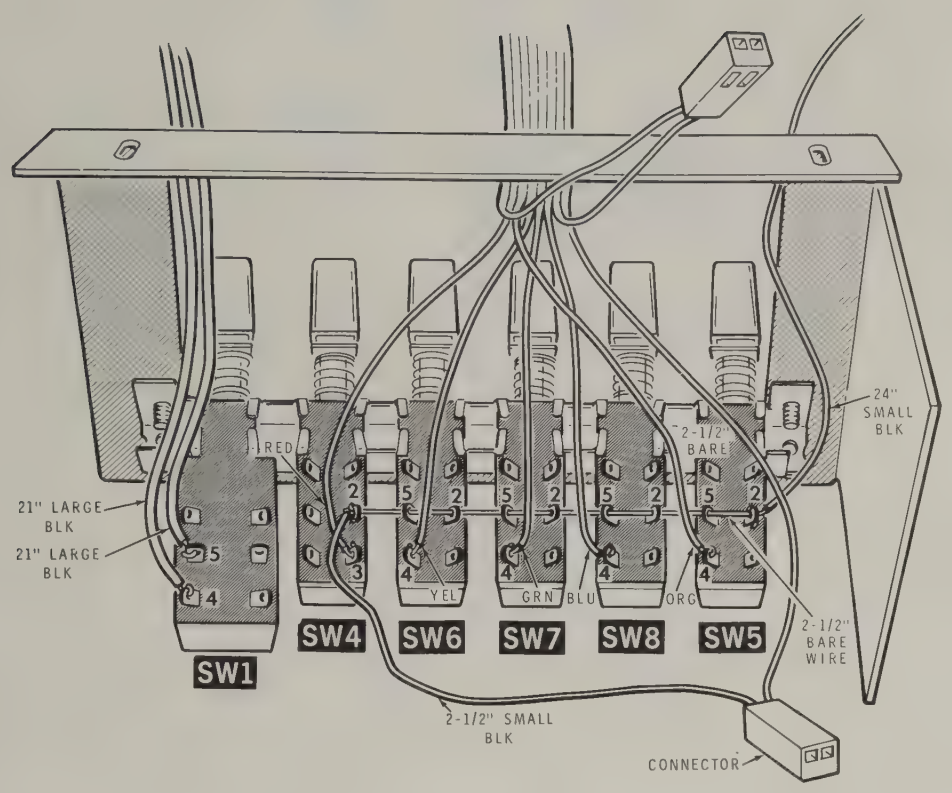




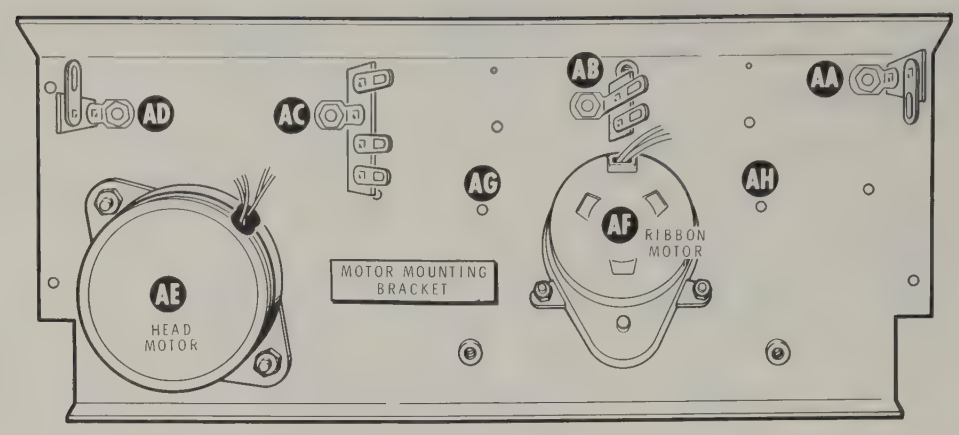
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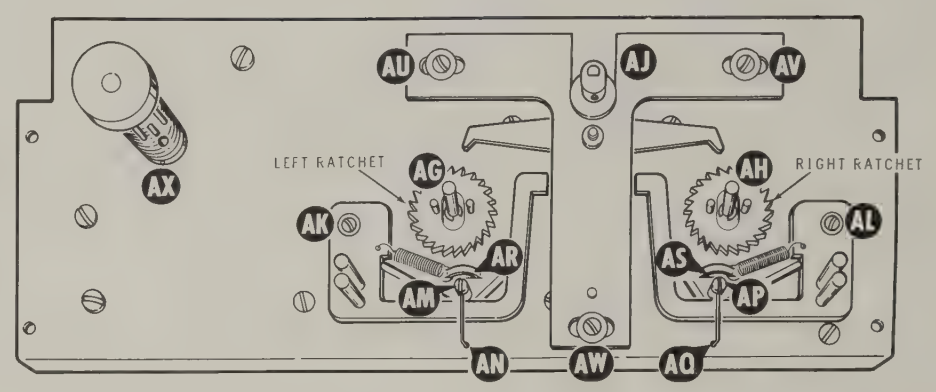




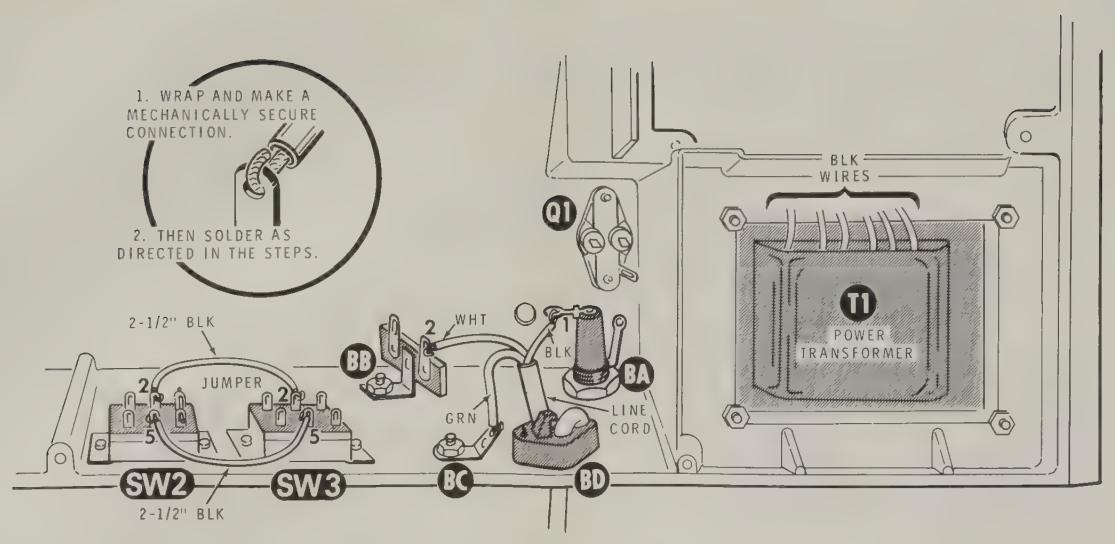
PICTORIAL 3-1



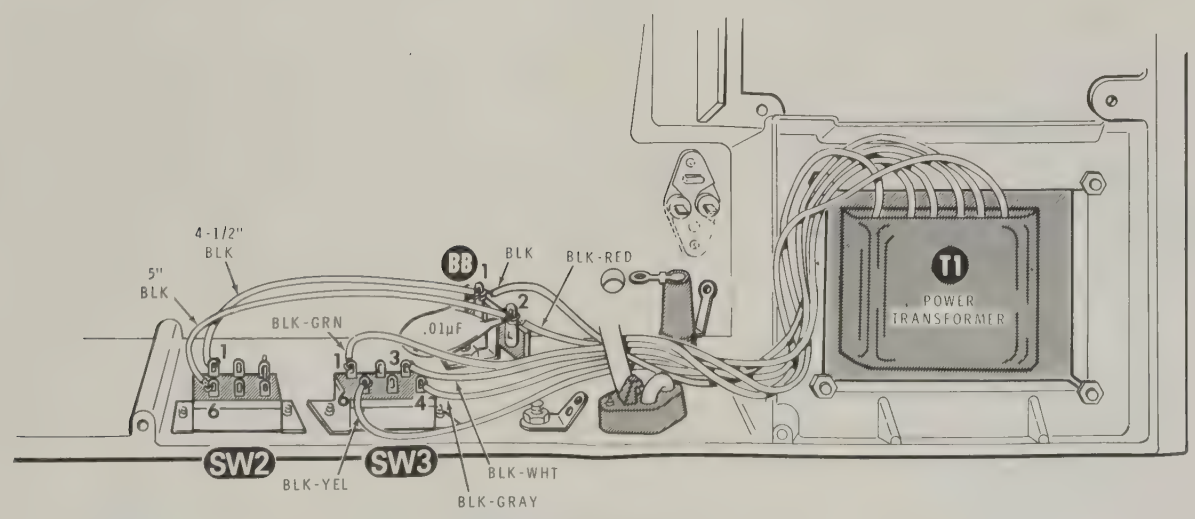
PICTORIAL 3-2



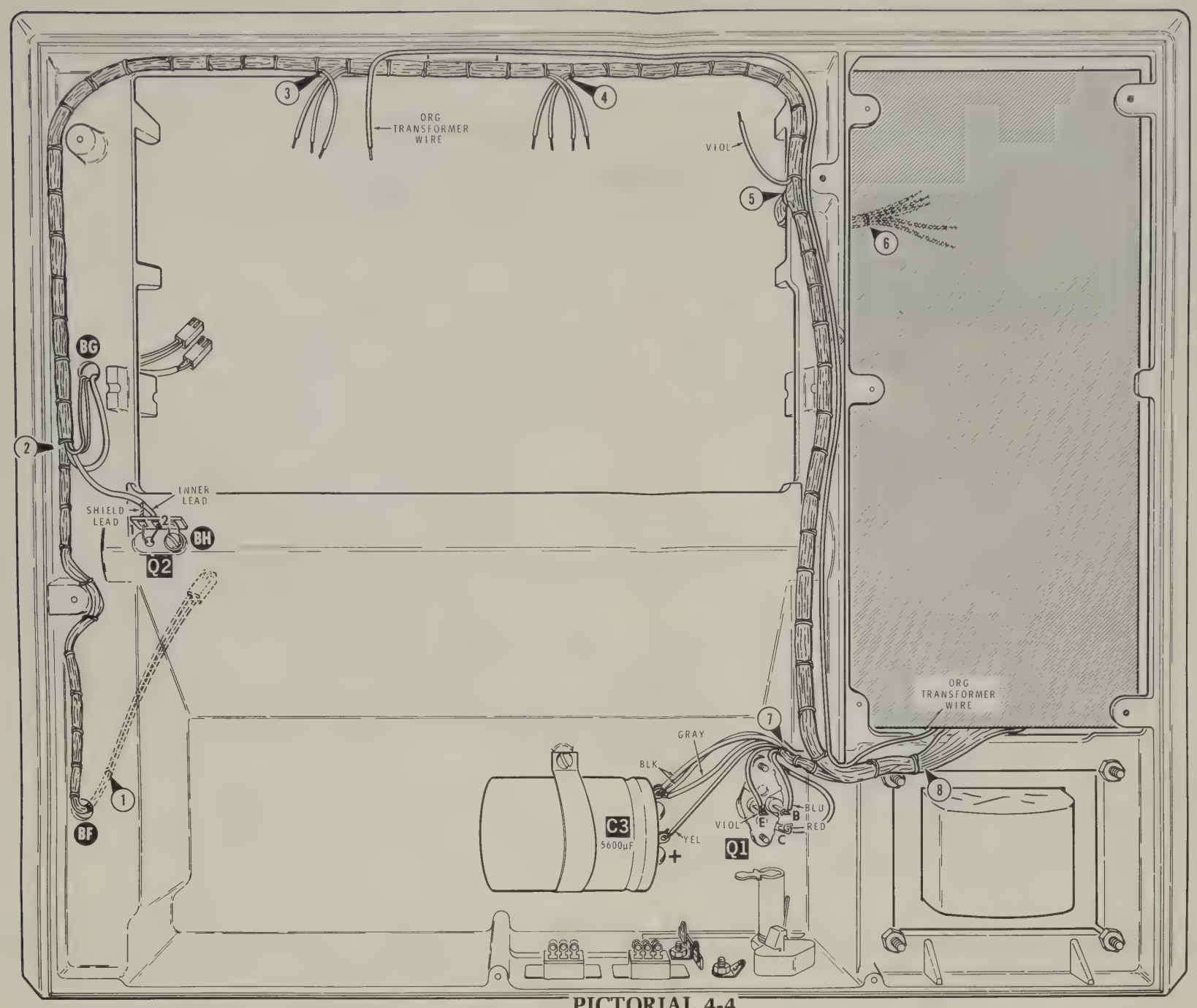
PICTORIAL 3-3



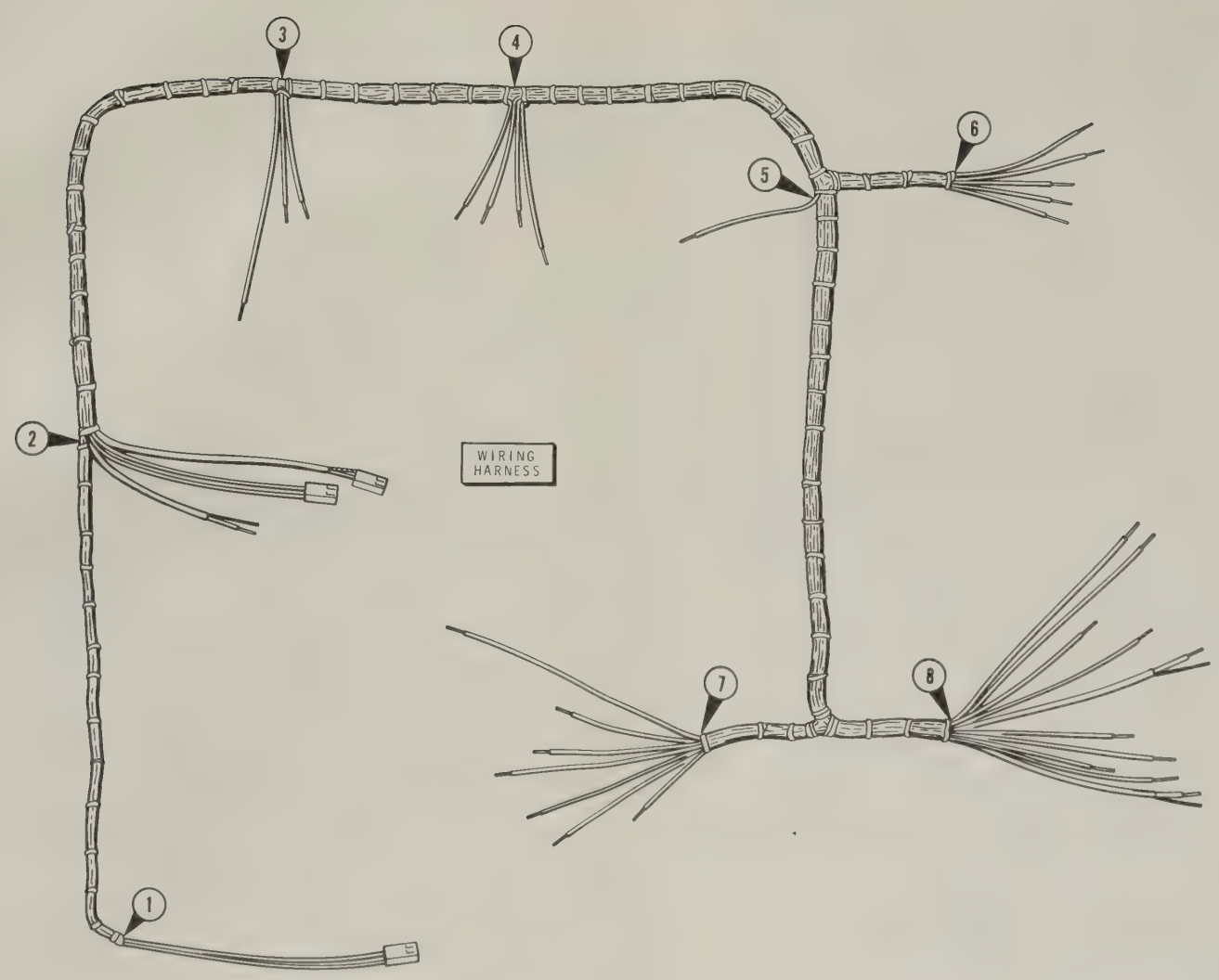
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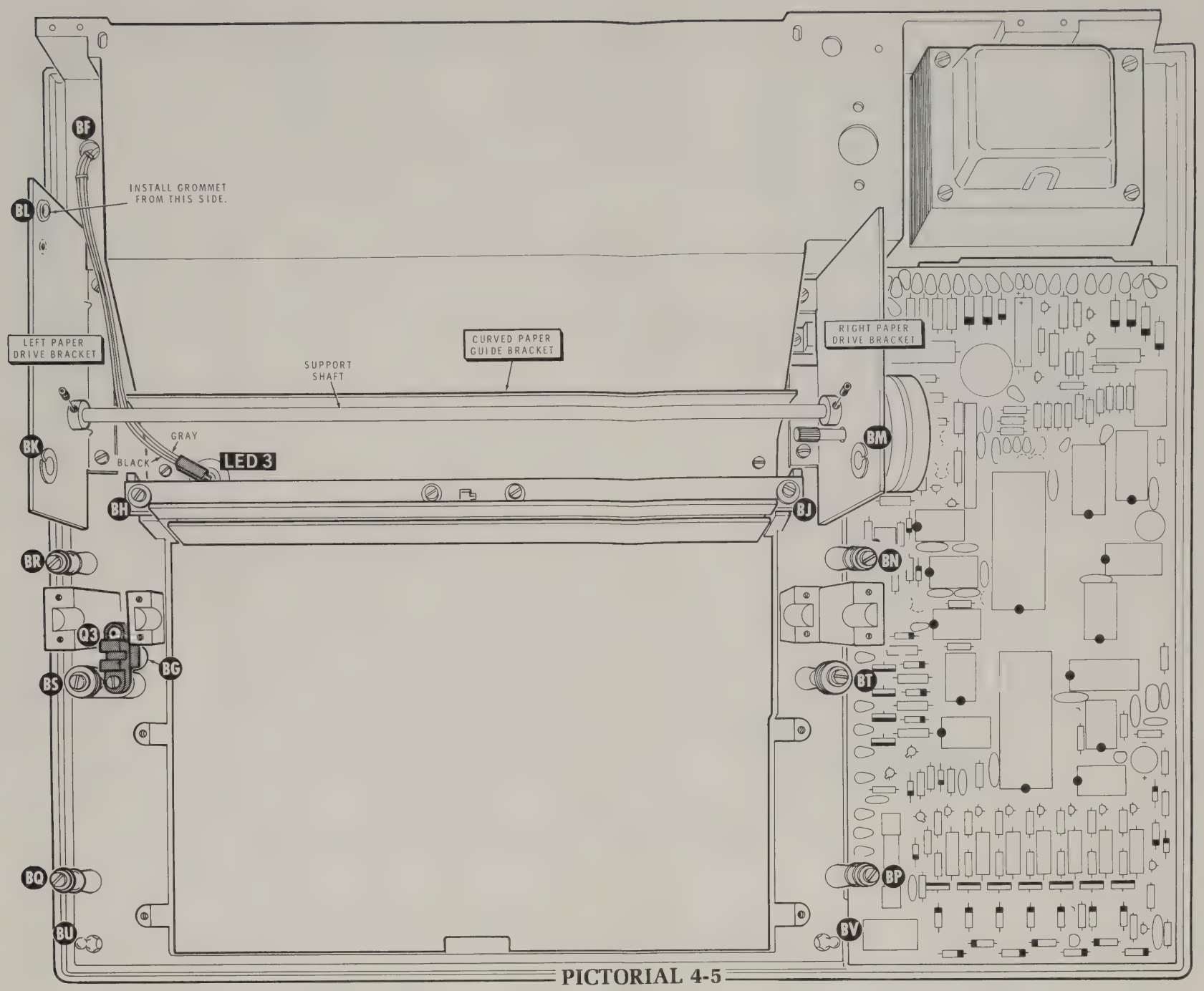
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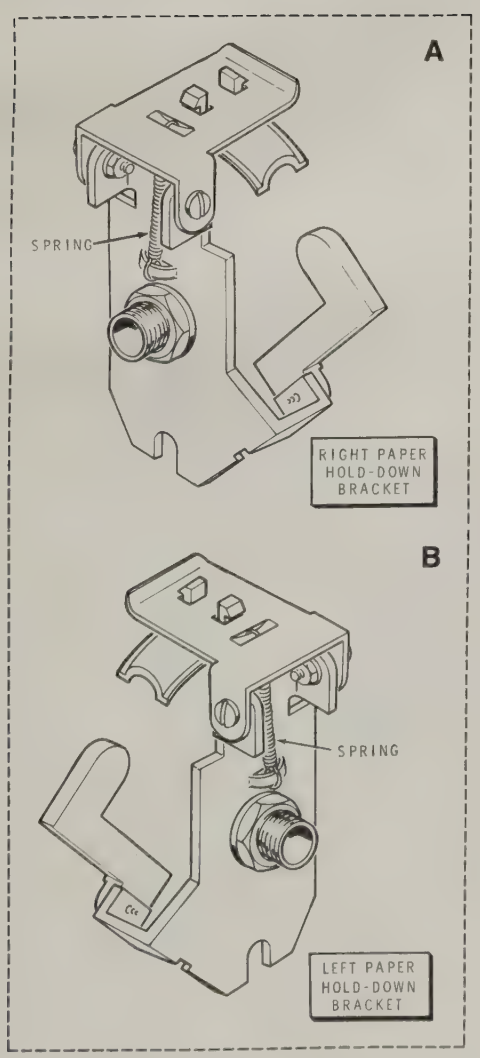
PICTORIAL 4-4



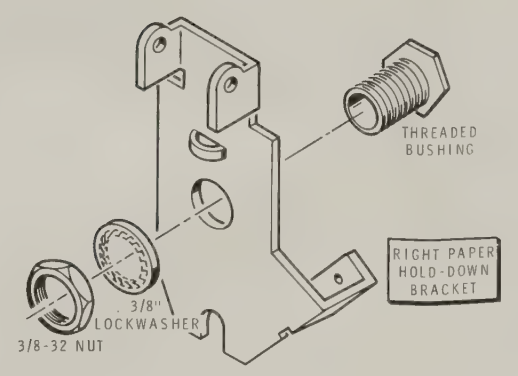
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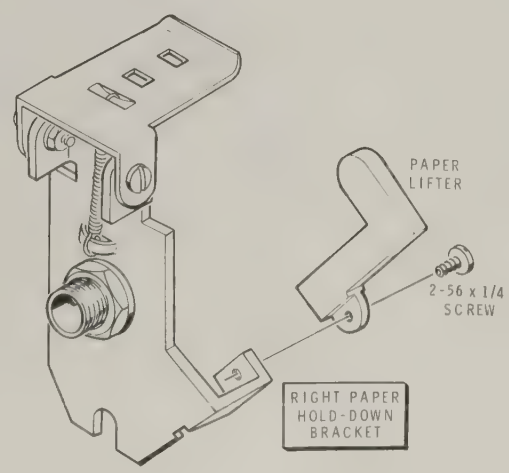
PICTORIAL 4-5



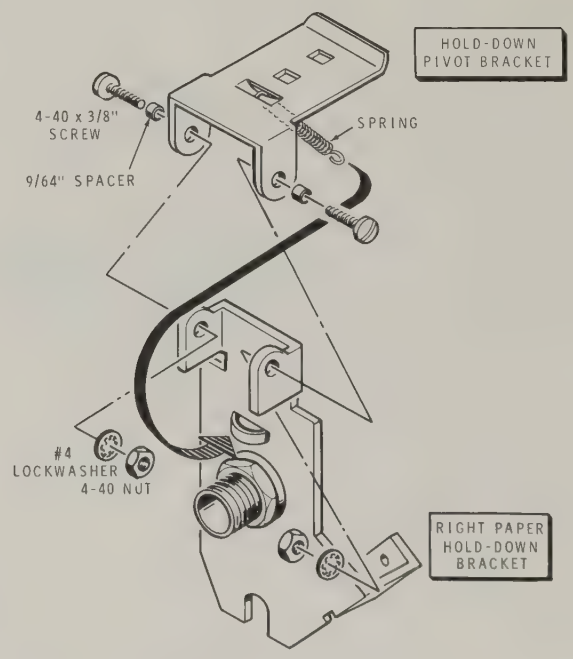
PICTORIAL 4-6



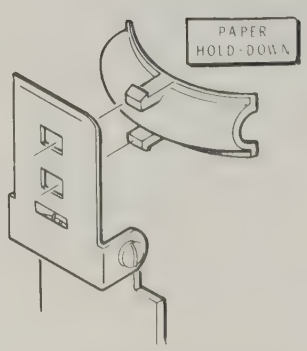
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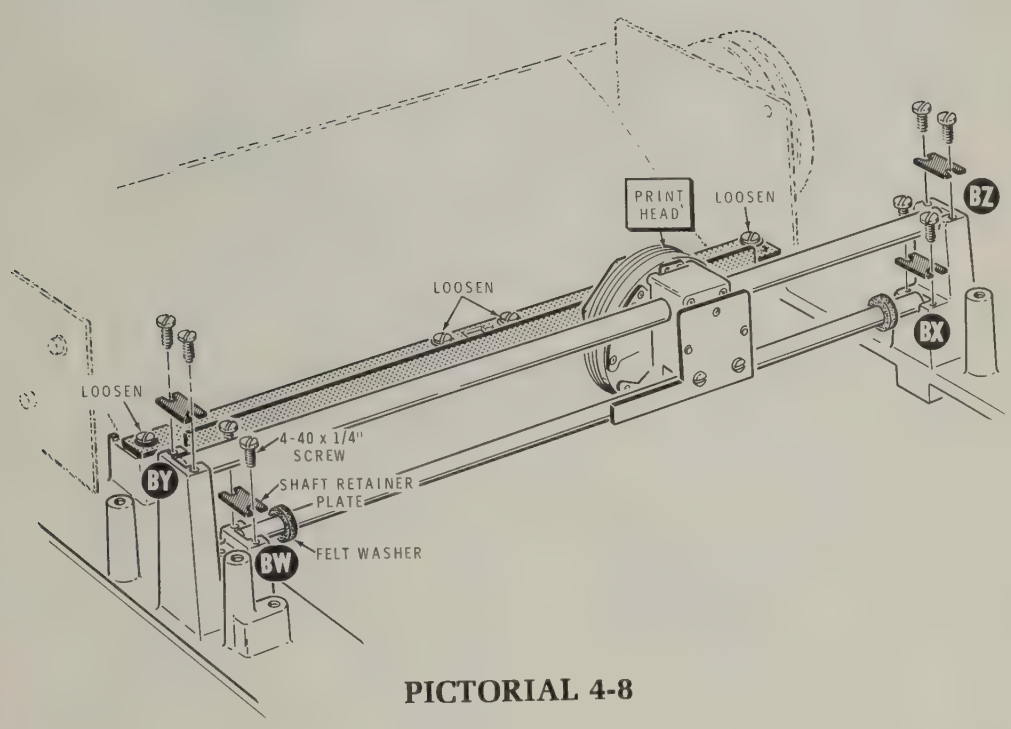
Detail 4-6C



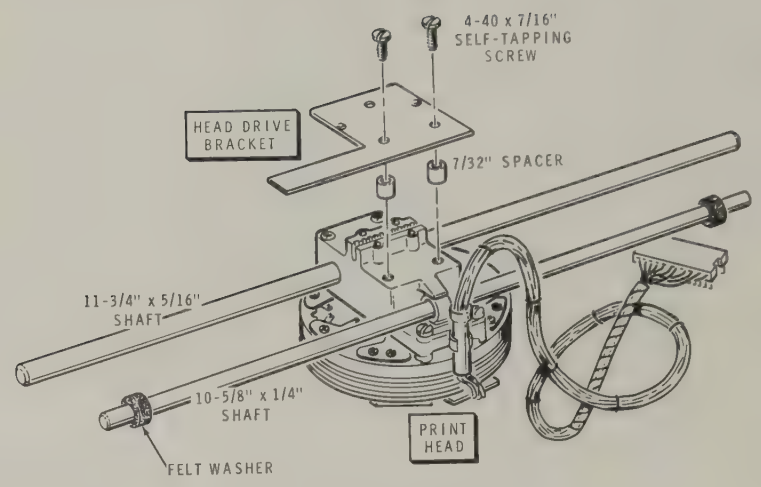
Detail 4-6B



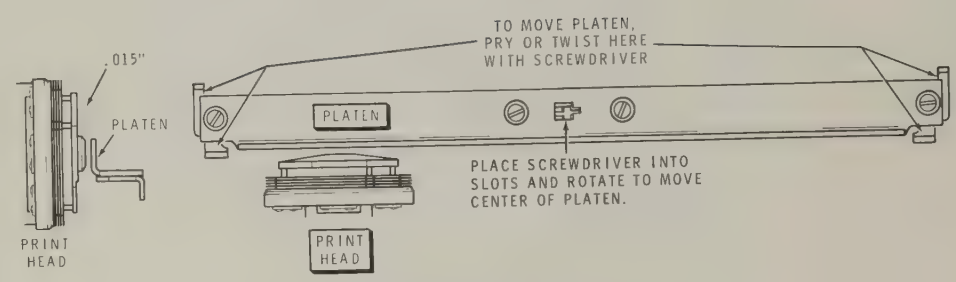
Detail 4-6D



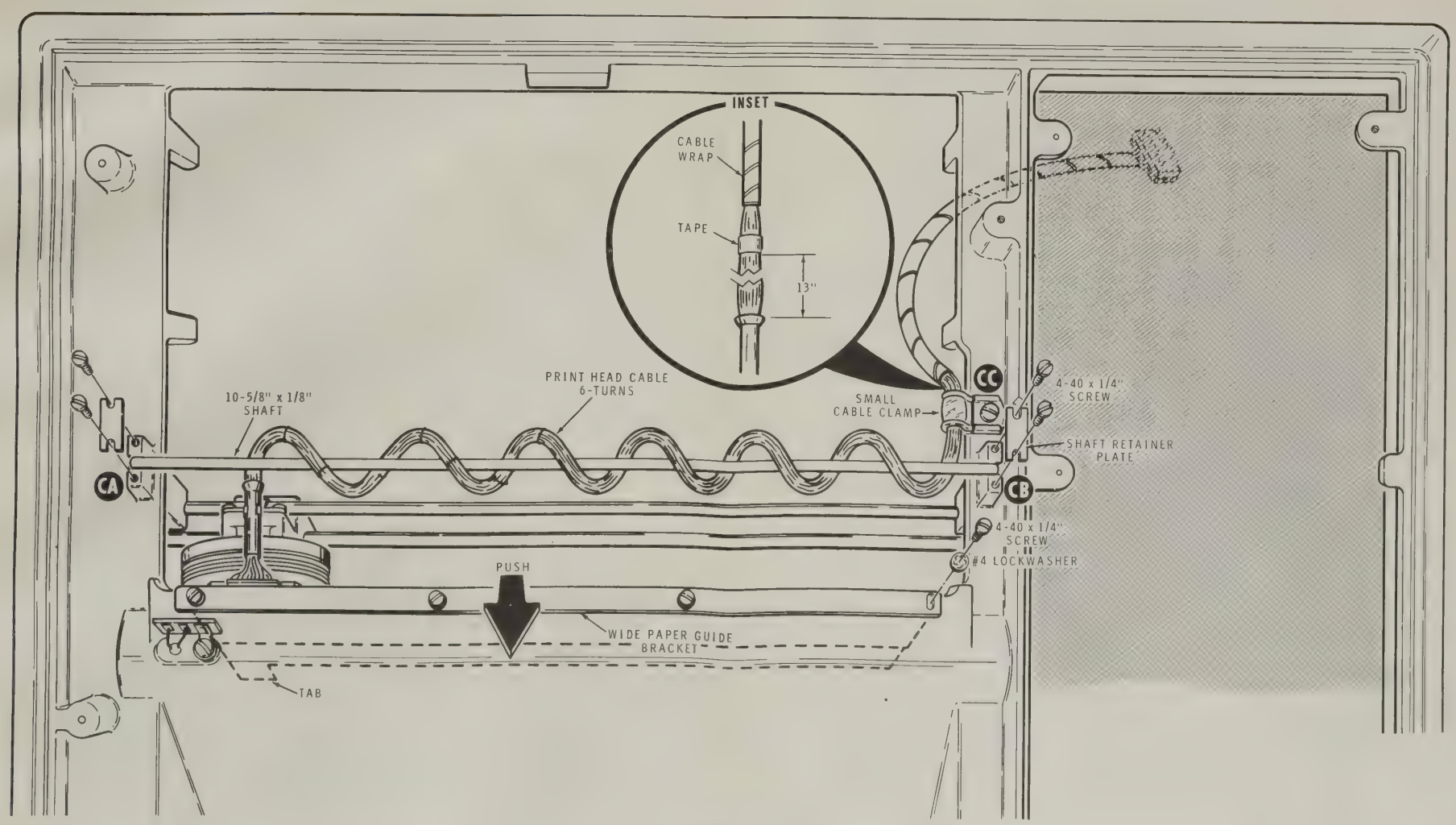
PICTORIAL 4-8



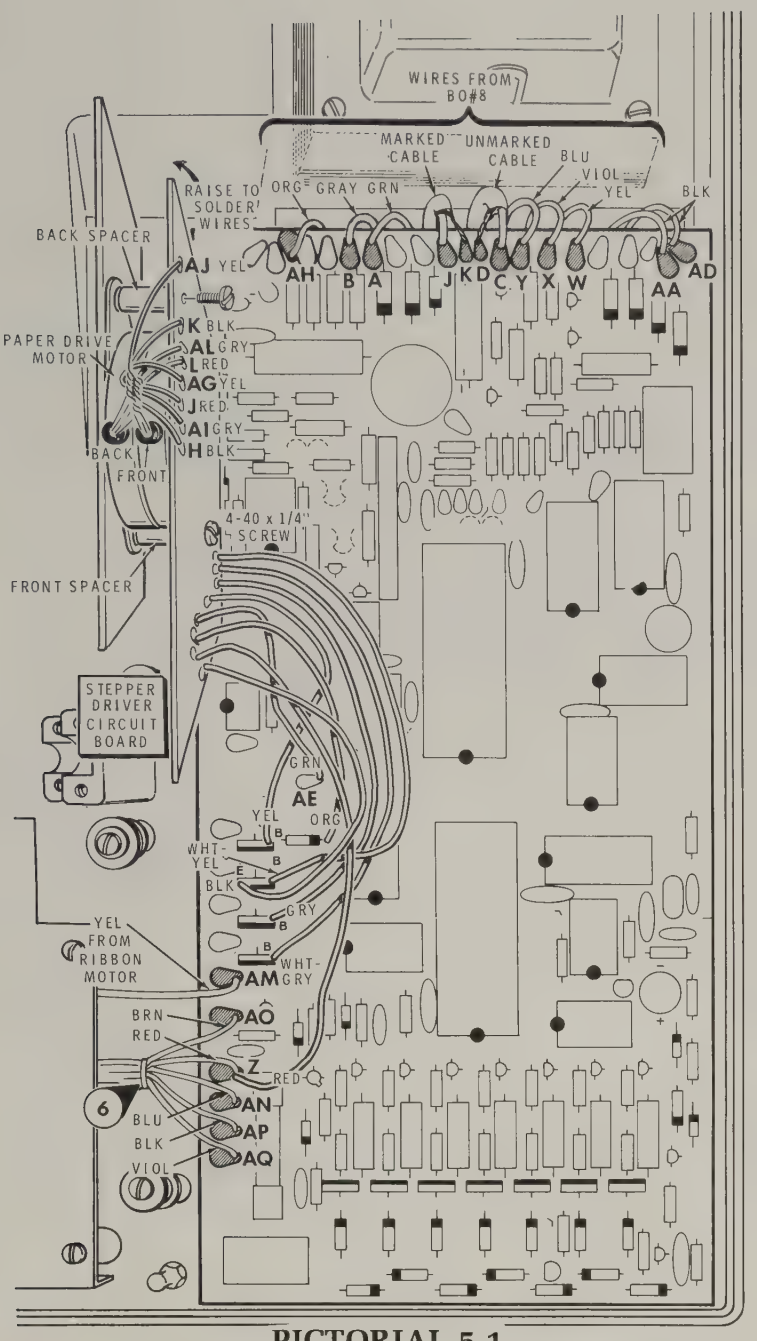
Detail 4-8A



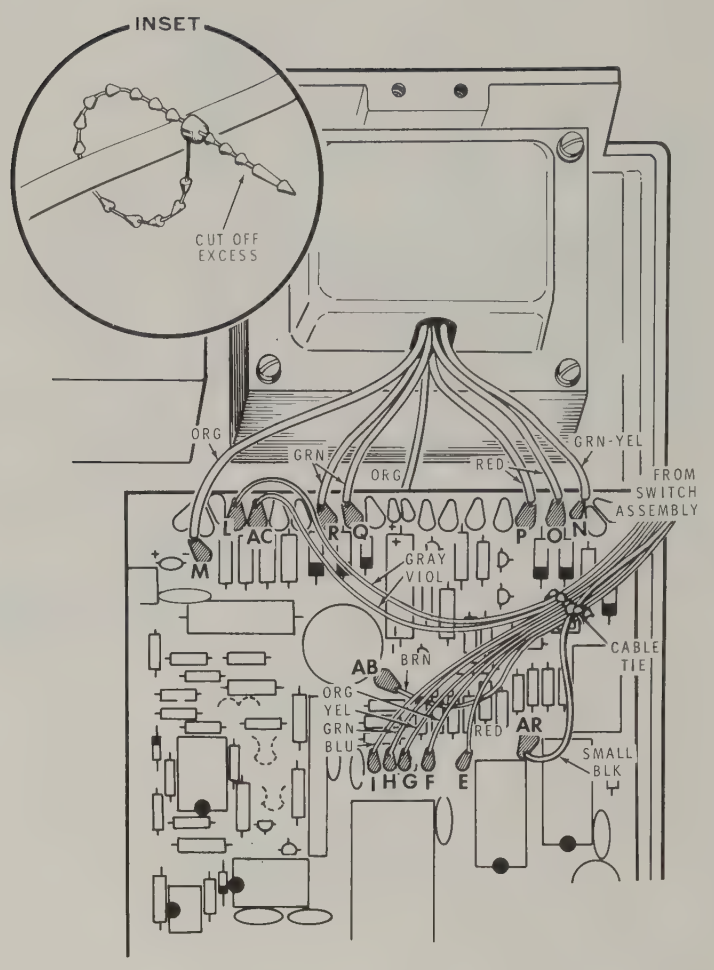
PICTORIAL 4-9



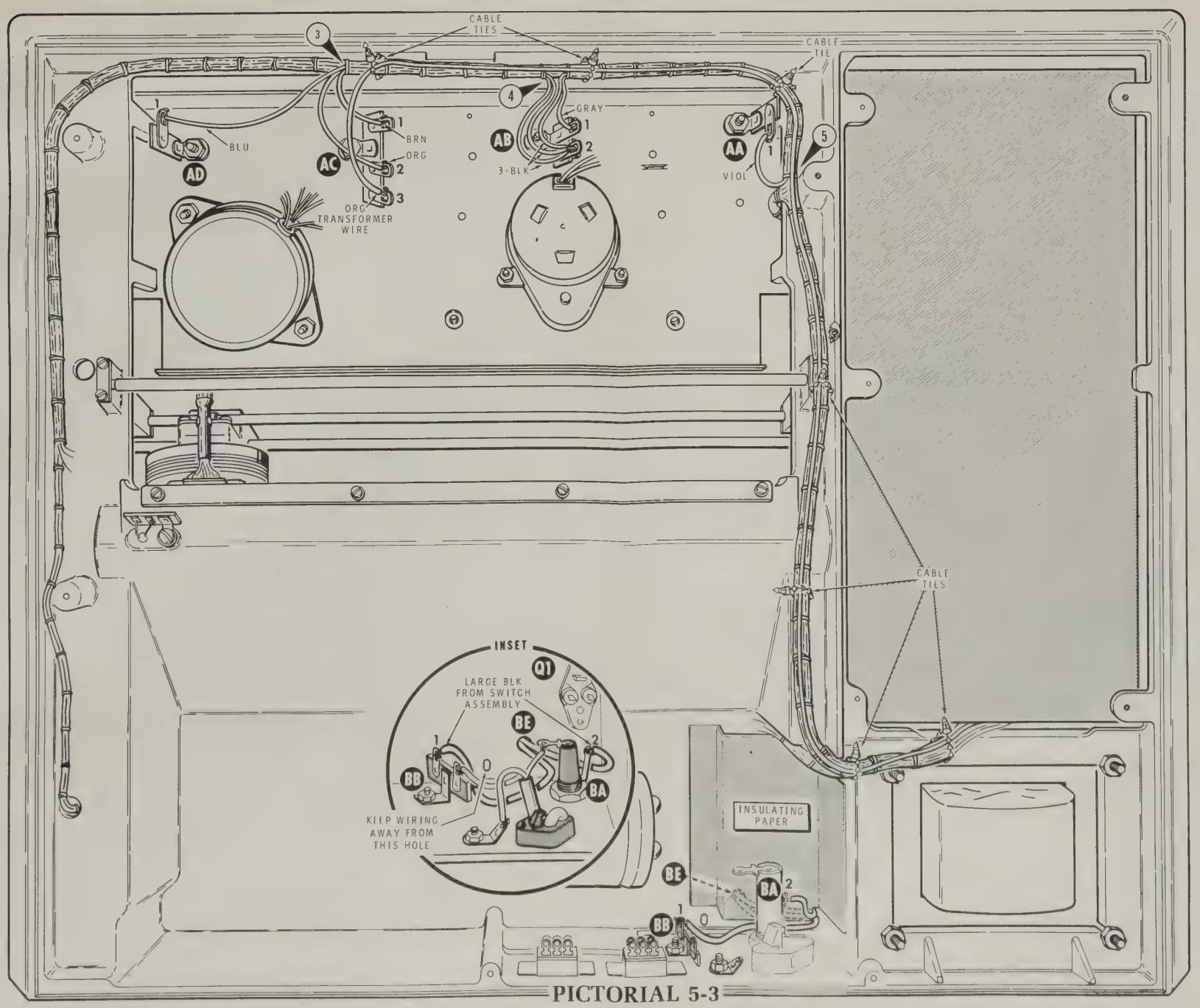
PICTORIAL 4-10



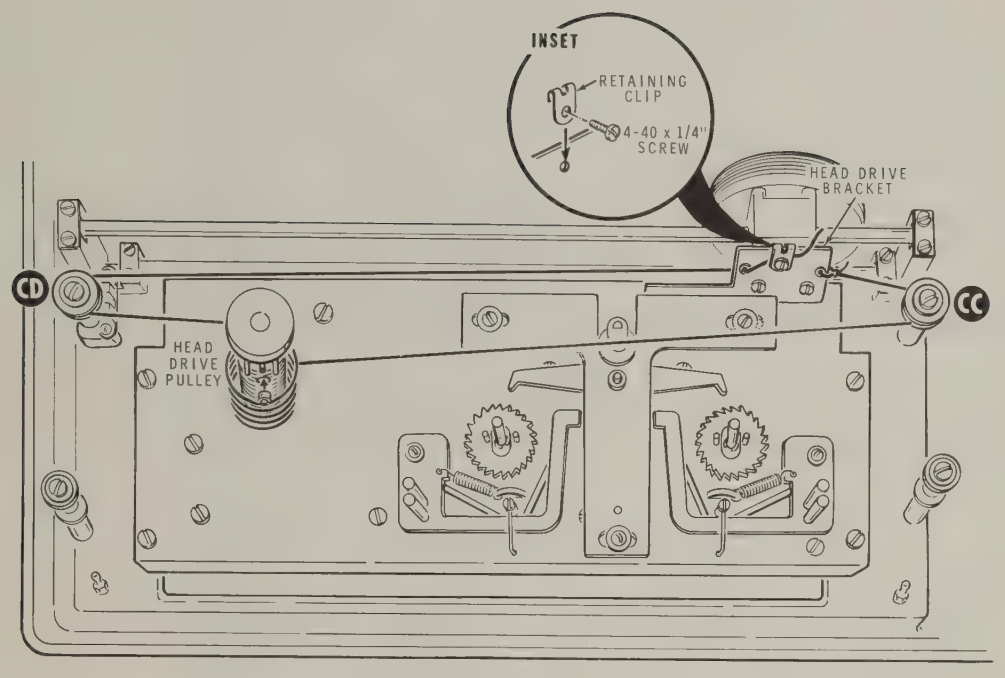
PICTORIAL 5-1



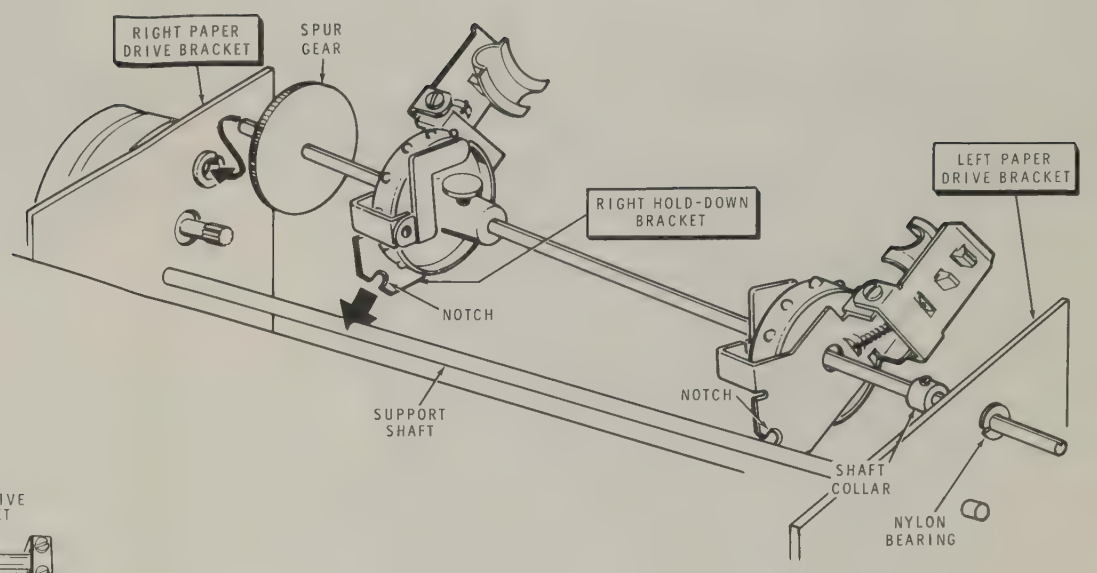
PICTORIAL 5-2



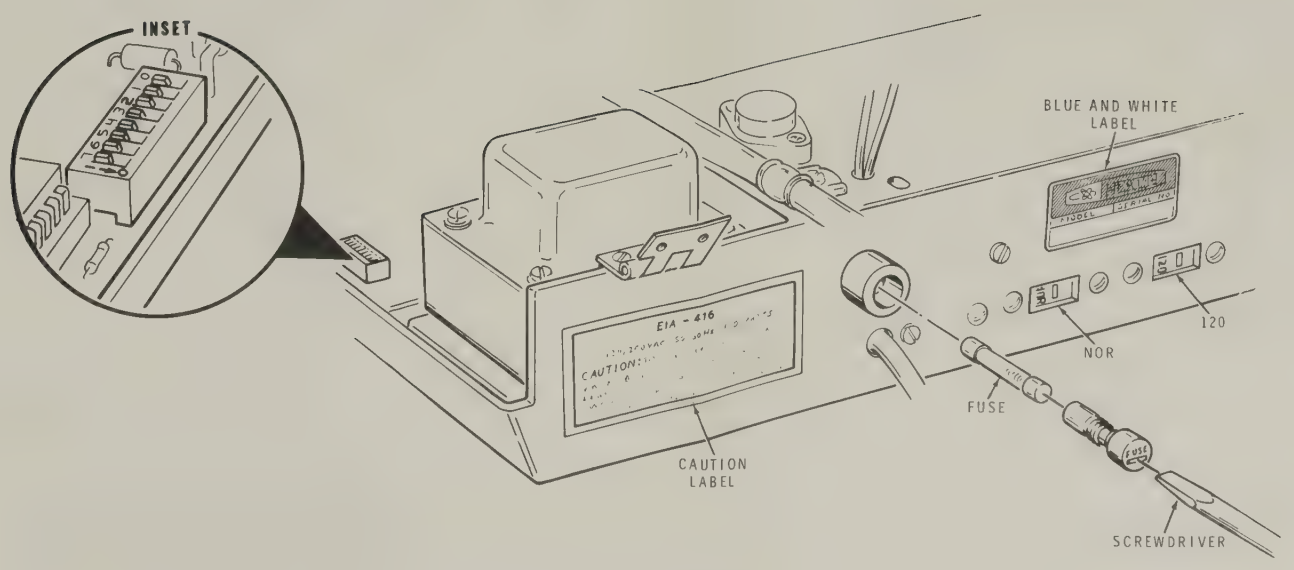
PICTORIAL 5-3



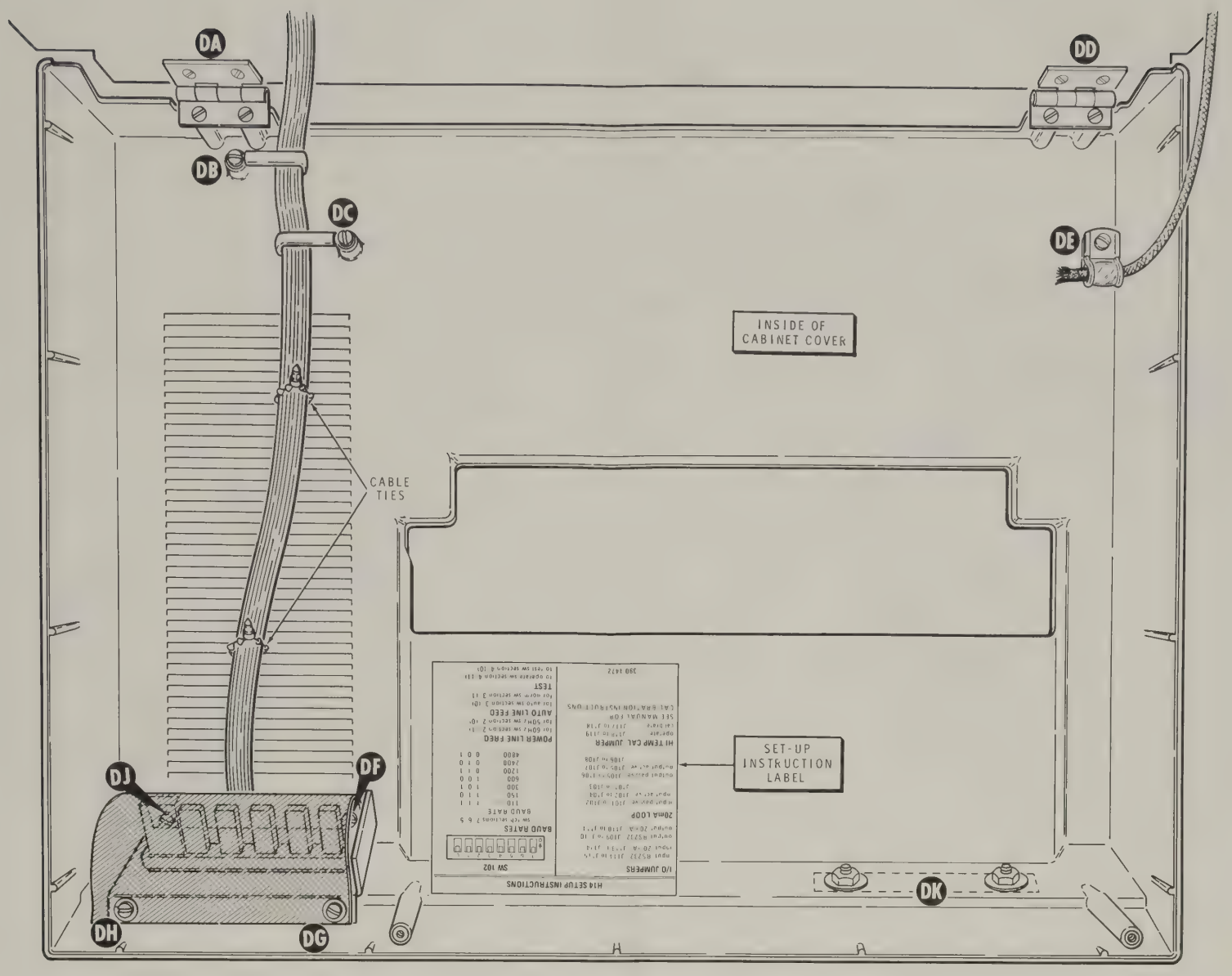
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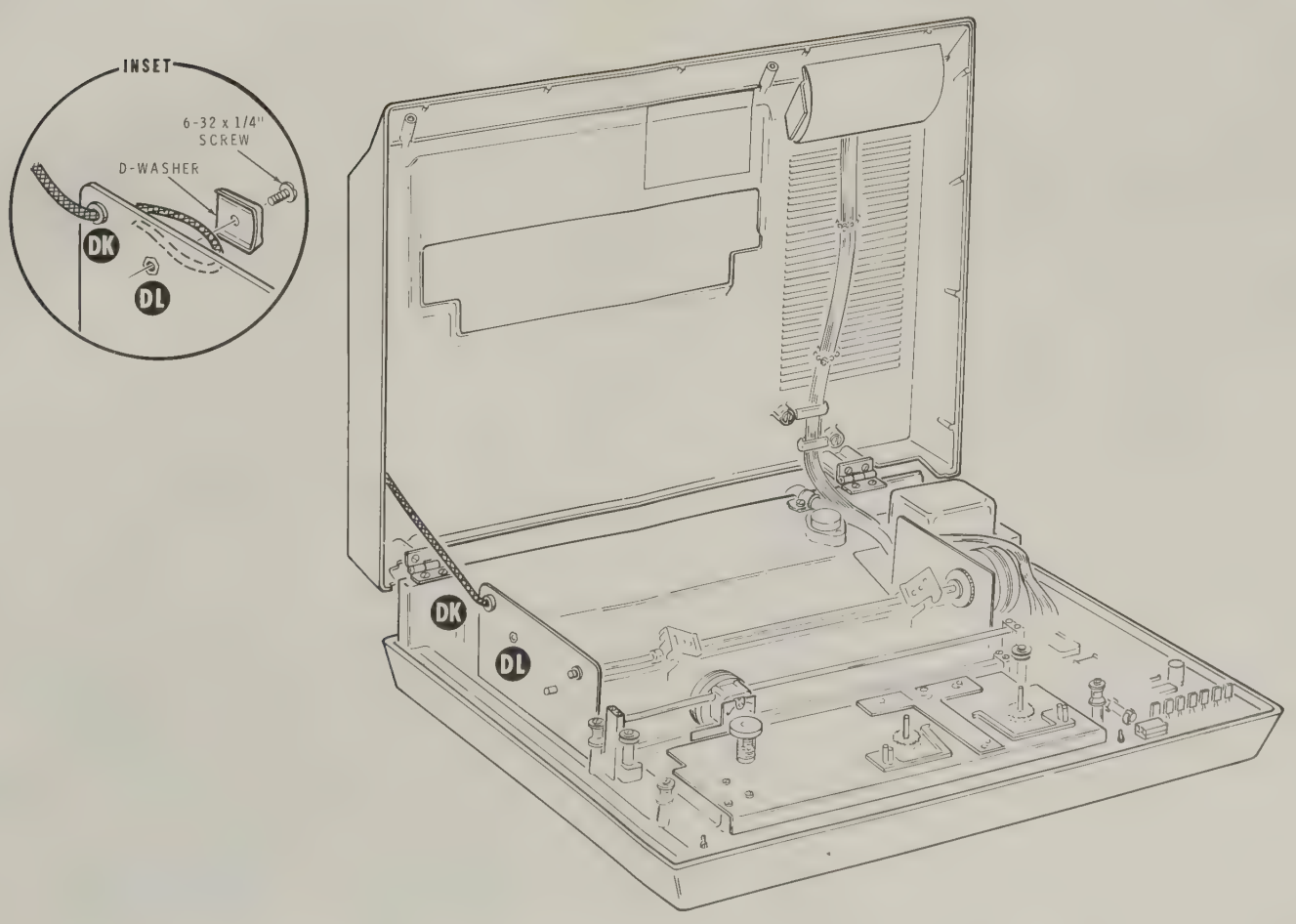
PICTORIAL 5-5



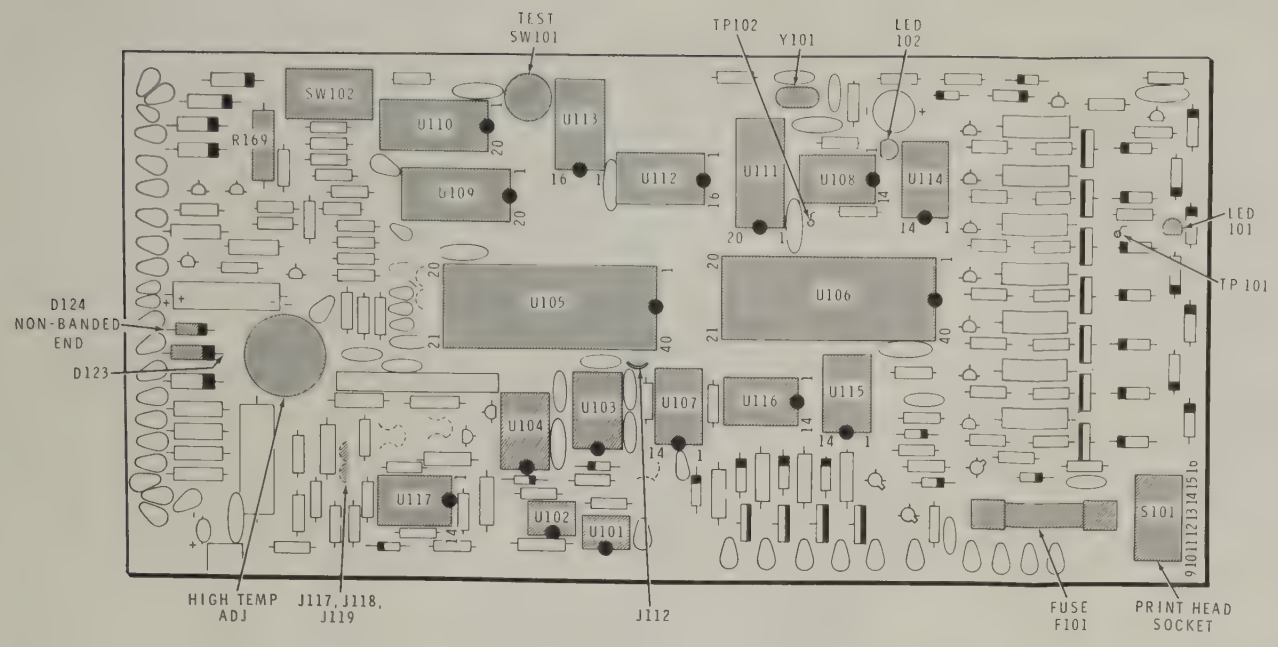
PICTORIAL 5-8



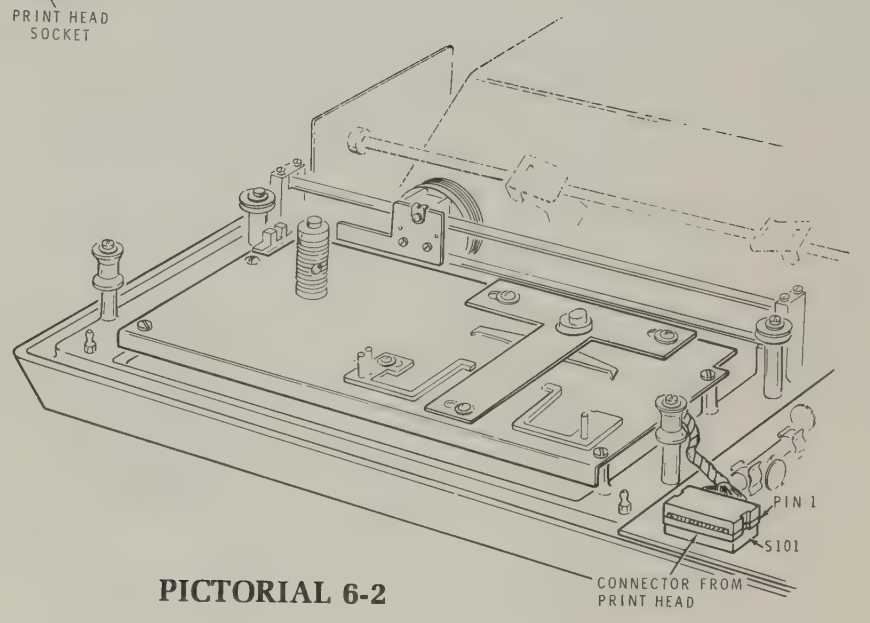
PICTORIAL 5-9



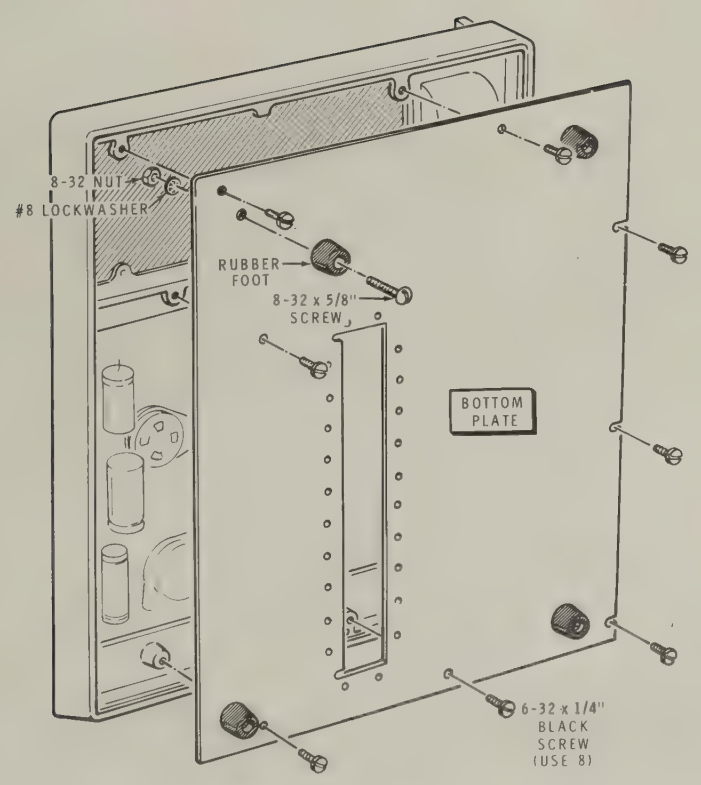
PICTORIAL 5-10



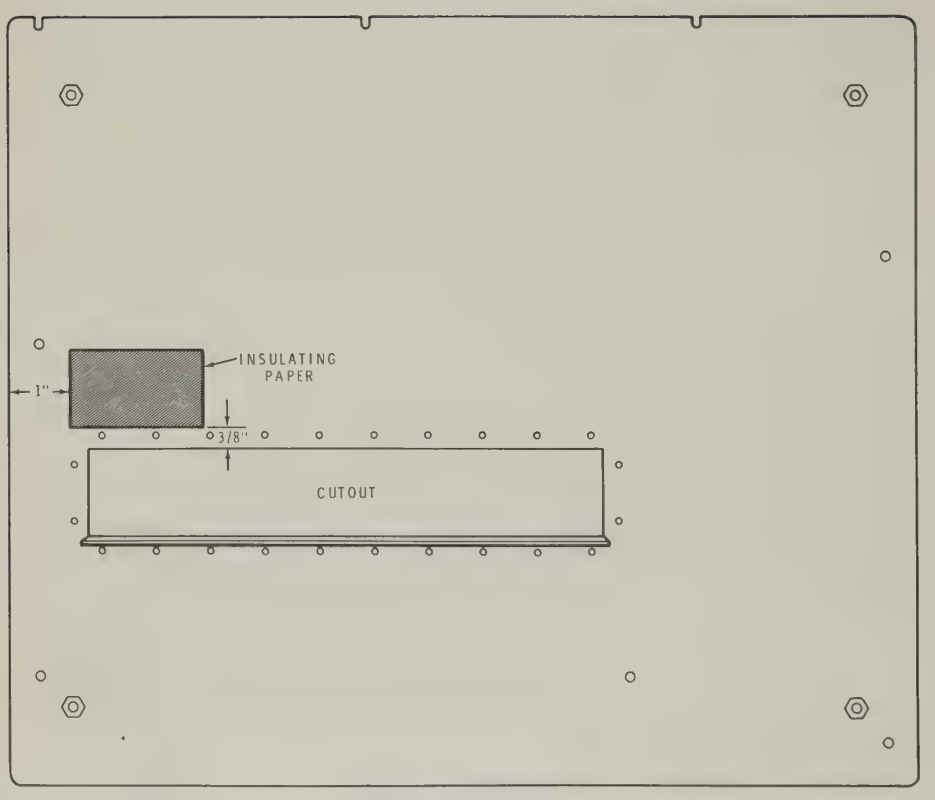
PICTORIAL 6-1



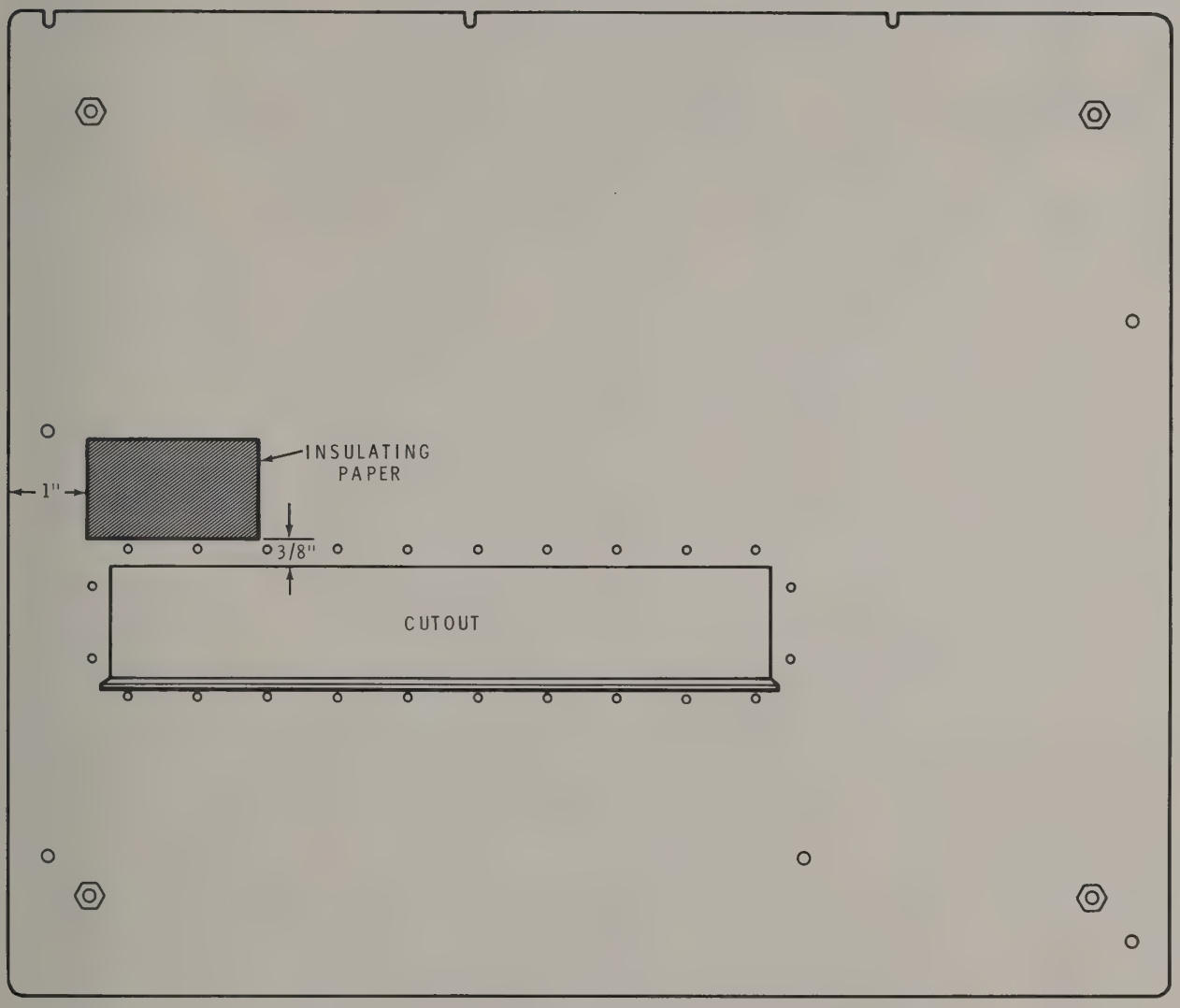
PICTORIAL 6-2



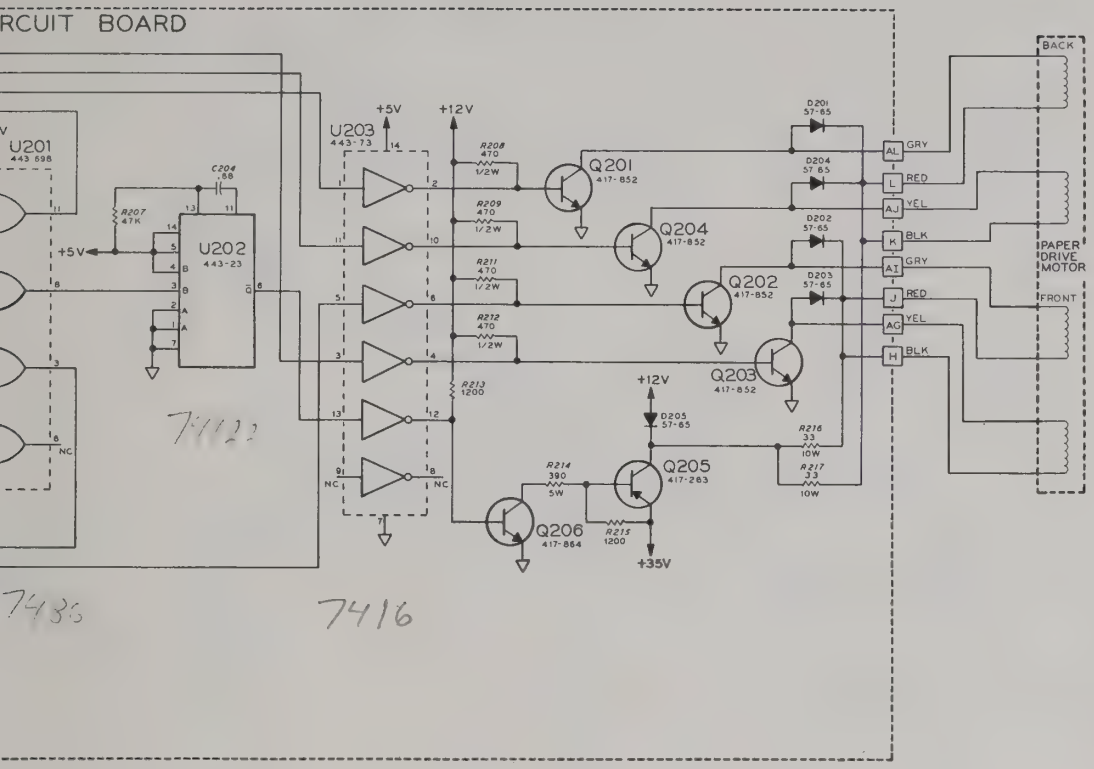
PICTORIAL 7-1

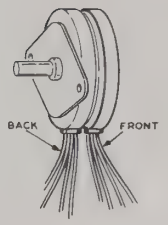


Detail 7-1A

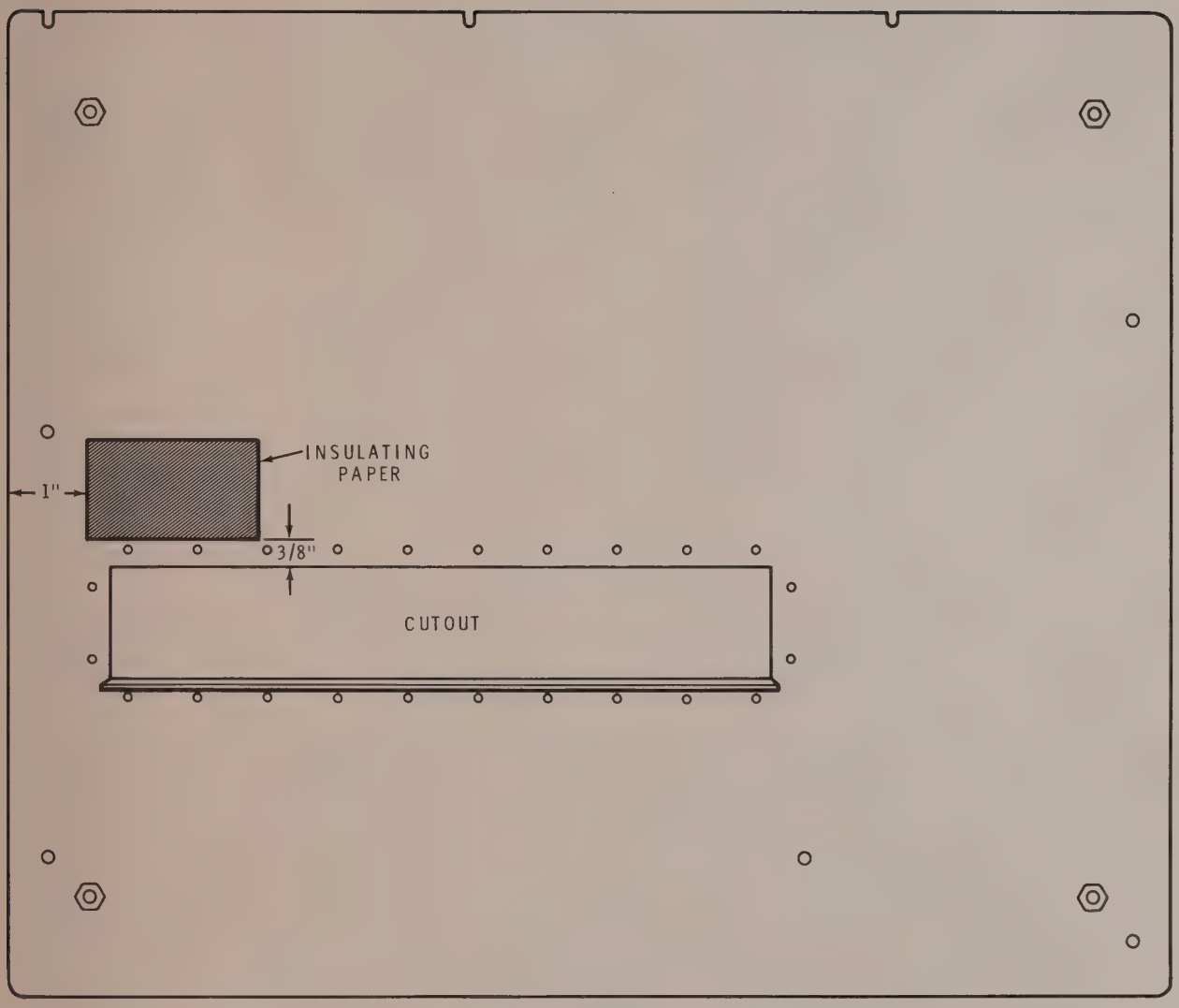


Detail 7-1A





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Detail 7-1A

SCHEMATIC OF THE HEATH LINE PRINTER

Model H14

Part of 595-2173-06

MAIN CIRCUIT BOARD

STEPPER DRIVER CIRCUIT BOARD

NOTES:

1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS.
 1-99 PARTS MOUNTED ON THE CHASSIS AND MAIN CIRCUIT BOARD.
 100-199 PARTS MOUNTED ON THE CIRCUIT BOARD.
2. ALL RESISTORS ARE 1/4 WATT UNLESS MARKED OTHERWISE RESISTOR VALUES ARE IN OHMS (K=1,000; M=1,000,000)
3. ALL CAPACITORS ARE IN µF UNLESS MARKED OTHERWISE
4. ▽ THIS SYMBOL INDICATES CIRCUIT BOARD GROUND.
5. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.
6. □ THIS SYMBOL INDICATES WHERE A WIRE IS SOLDERED TO A CIRCUIT BOARD.
7. ⋙ THIS SYMBOL INDICATES A CONNECTOR.
8. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%.
9. PARTS IN SHADED AREAS ARE CRITICAL FOR CONTINUED SAFETY. REPLACE THEM ONLY WITH PARTS OF THE SAME RATING OR WITH THE PROPER HEATH PARTS.

S2 ON CIRCUIT BOARD — 25-PIN D CONNECTOR

PGND	1	1
OUT	2	14
SOUT	3	2
BUSY	4	15
SIN	5	3
OUT-	6	16
RTS	7	4
N.C.	8	17
CTS	9	5
IN+	10	18
DSR	11	6
IN-	12	19
SGND	13	7
DTR	14	20
RLSD	15	8

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SCHEMATIC OF THE HEATH LINE PRINTER

Model H14

Part of 595-2173-06

ERS ARE IN THE FOLLOWING GROUPS.
TED ON THE CHASSIS AND MAIN CIRCUIT

OUNTED ON THE CIRCUIT BOARD.

RE 1/4 WATT UNLESS MARKED OTHERWISE.
ARE IN OHMS (K=1,000; M=1,000,000).

ARE IN µF UNLESS MARKED OTHERWISE.

INDICATES CIRCUIT BOARD GROUND.

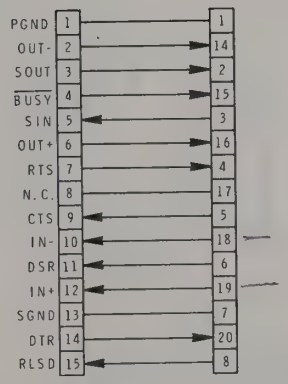
INDICATES CHASSIS GROUND.

INDICATES WHERE A WIRE IS SOLDERED
T BOARD.

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MPEDANCE VOLTMETER FROM THE POINT
O CHASSIS GROUND. VOLTAGES MAY VARY

AREAS ARE CRITICAL FOR CONTINUED
THEM ONLY WITH PARTS OF THE SAME
HE PROPER HEATH PARTS.



20 mA Current Loop

To use the current loop, install jumper wires between circuit board holes J113 and J114, and J110 and J111.

Current loop operation of data terminal equipment is normally done in the passive mode. This requires the installation of jumper wires between J101 and J102, and J105 and J106.

The Schematic Diagram and previous cable lead identification chart indicate the polarity of current loop signals for passive operation. For active operation, the polarities of these signals are reversed. Remove the passive loop jumper wires and then install jumpers between:

J101 and J103
J102 and J104 } Input

J105 and J107
J106 and J108 } Output

Operating levels for current loop operation are:

Transmitter

Voltage drop (marking)	2.0 volts max.
Spacing current	2.0 mA max.
Marking current	20 mA min.

Receiver

Voltage drop (marking)	2.7 volts max.
Spacing current	3.0 mA max.
Marking current	15 mA min.

Proceed to the "Operation" section.

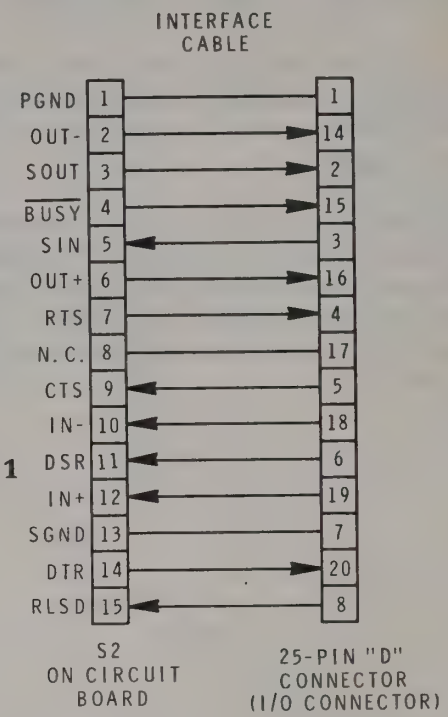
NON-HEATH SYSTEM CONFIGURATION

INTERFACING

The following chart describes the leads of the I/O cable. Also, see Pictorial 1.

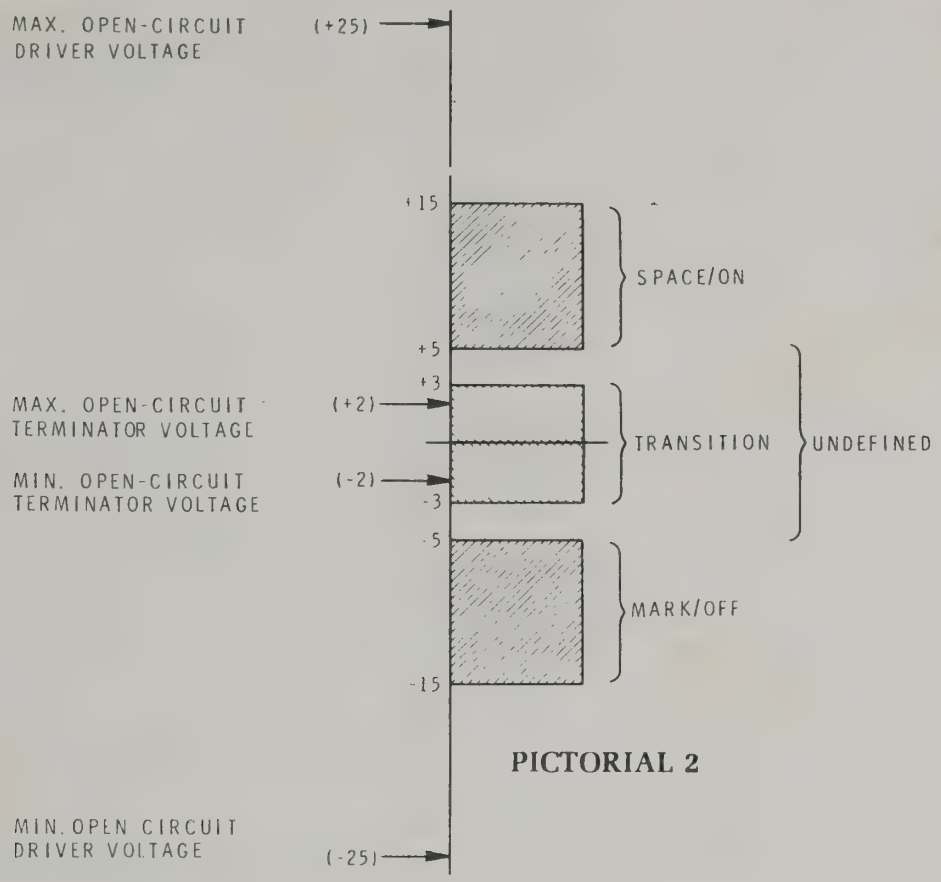
NOTE: If you use a baud rate higher than 110, the system must use handshaking. See "Printer Handshaking" below.

PICTORIAL 1



I/O Pin #	LEAD COLOR	SIGNAL NAME
1	Black	Protective ground (P GND)
2	Red	RS-232C Serial Output (S OUT)
3	Orange	RS-232C Serial Input (S IN)
4	Black-white	Request to send (RTS) Output (Printer Busy)
5	Not Used	
6	Black-blue	Data set ready (DSR)*
7	White-red	Signal ground (SGND)
8	Not Used	
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	
13	Not Used	
14	White	Current loop output − (OUT−)
15	Green	Printer not busy ($\overline{\text{BUSY}}$) output *
16	Blue	Current loop output + (OUT+)
17	Black-red	Not used
18	Black-orange	Current loop input − (IN−)
19	White-black	Current loop input + (IN +)
20	White-green	Data terminal ready (DTR) output
21	Not Used	
22	Not Used	
23	Not Used	
24	Not Used	
25	Not Used	

*These lines not required for Printer operation.



PICTORIAL 2

All control signals are at RS-232C levels. (See Pictorial 2.) All controls are "on" in the space condition (binary 0). All I/O signals are at "mark" during all intervals between valid data transfers.

PRINTER HANDSHAKING

Request to Send (RTS)

RTS (Pin 4) may be used as a printer busy signal. This allows data to be transmitted at baud rates greater than 110 without a chance of losing characters, and still allows the system to operate at its maximum rate. When the Printer's line buffer is full, the RTS line goes to the "on" state and will remain there until the buffer can accept more characters. When RTS goes "on," there is room for sixteen more characters in the buffer.

The printer busy signal is available at pin 15 of the 25-pin D-connector. It has an EIA "off" (negative) level when the printer is busy, and an EIA "on" (positive) level when the printer can take additional characters.

An additional handshake signal is generated in the form of control Q and control S, which is transmitted on the regular data output channel. When the line buffer is full, the RTS output goes to the "on" state and the control S signal will be sent. When more data can be accepted, the Printer will send "Control Q" and the RTS will go "off."

NOTE: If the Printer stops unexpectedly, restart by using the "Off Line" switch. No characters will be missed.

Data Terminal Ready (DTR)

The DTR signal is "on" whenever the AC power is on.

PRINTER BAUD RATE AND SIGNAL LEVELS SELECTION

Refer to "Printer Baud Rate Selection" and "Printer Signal Levels Selection" on Page 6.

OPERATION

Refer to Pictorial 3 for a description of the front panel switches.

WIDE CHARacter switch (SW5): When pushed "in," approximately 10 characters per inch are printed (maximum of 80 characters per line). When "out," approximately 16.5 characters per inch are printed (maximum of 132 characters per line). The above is true on power up. Additionally, either side of the switch may be serially programmed to 80, 96, or 132 characters. Character pitch will not change during the printing of a line.

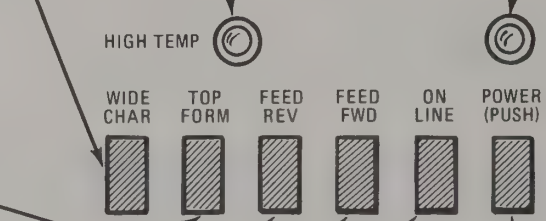
TOP FORM switch (SW8): When power is turned on, "top of the form" is initialized. The Printer assumes that the paper is positioned at the top of the next form. Use the FEED switches and advance the form to the desired position for the top of the form. Pressing and releasing the switch will cause the paper to advance to the top of the next form. (Upon power up, the form depth is set to 11 inches.) To modify the form depth:

1. Press in and hold this switch.
2. Feed the form to the desired length using the FEED switches.
3. Release the TOP FORM switch.

This switch is operative only when "off line." It is necessary to reset the form parameters whenever power is interrupted.

FEED REVerse switch (SW7): Pull lightly on the paper to prevent jamming. Operation is the same as FEED FWD except for the direction of feed.

FEED FWD (forward) switch (SW6): Momentarily depressing this switch causes the paper to advance approximately .02 inches and stop. Holding the switch down causes the paper to advance to the next line. Further holding of the switch will cause the paper to advance one full line at a time.



HIGH TEMP LIGHT (LED2): Lights when maximum print head temperature is reached and printing will stop. It is normal for this LED to flicker when printing is being done.

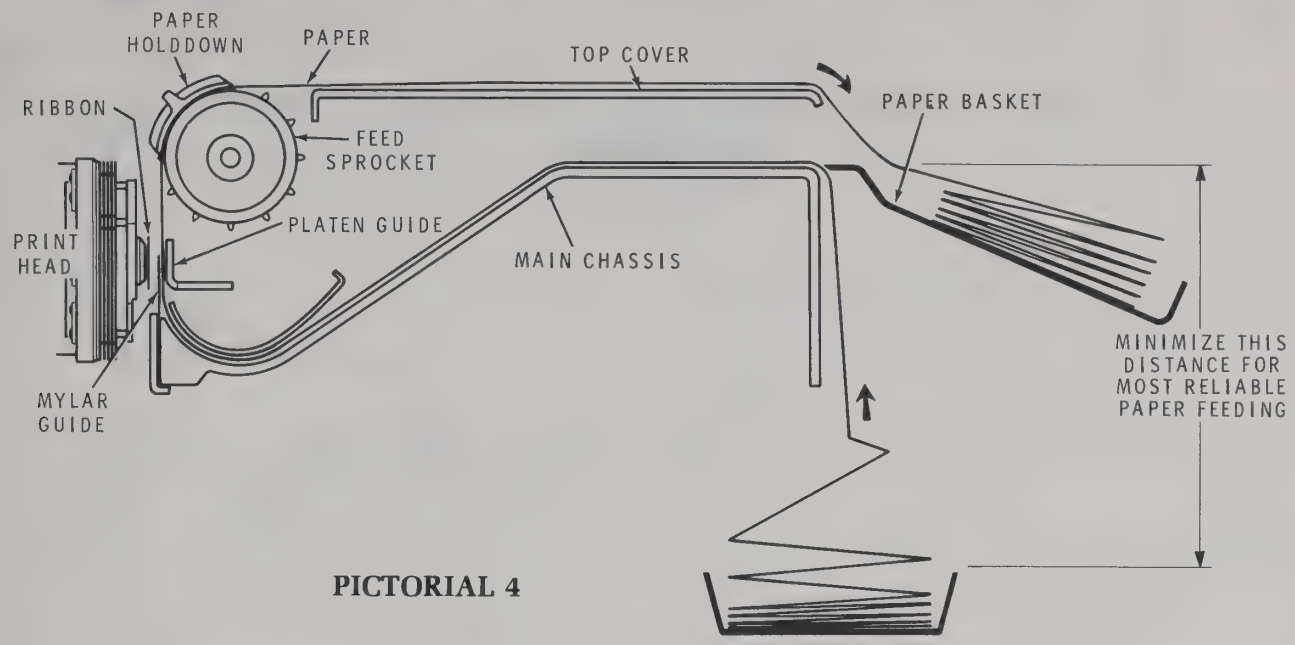
POWER indicator (LED1): Lights when AC power is turned on.

POWER switch (SW1): Push it in to turn the Printer on.

ON LINE switch (SW4): When pushed in, the Printer will receive information from the I/O and process it. When out, the Printer will continue to receive information only until the line buffer is full. Hardware handshaking will indicate busy when nearing "buffer full," just as when "on line." The other manual switches are operative only in this "off line" condition. NOTE: A line that is being printed when taken "off line" will be completed. Any remaining characters will be held in the line buffer until the Printer is put back "on line" again.

Push "off line" and then back "on line" to restart after paper jamming or running out of paper.

PICTORIAL 3



PICTORIAL 4

POWER LINE CONSIDERATIONS

If you change the position of the rear panel 120/240 switch, be sure you change fuse F1 to the proper value as follows:

For 120 VAC, use a 1-ampere, 125-volt, slow-blow fuse.
For 240 VAC, use a 1/2-ampere, 250-volt, slow-blow fuse.

Be sure the NOR/LOW switch is set in its proper position to match your line voltage as follows:

NOR range — 115 V to 135 V rms or 230 V to 270 V rms.
LOW range — 100 V to 120 V rms or 200 V to 240 V rms.

NOTE: If you do not know the value of the line voltage in your area, set the NOR/LOW switch to NOR.

Inside your Printer, set section two of circuit board switch SW102 as follows:

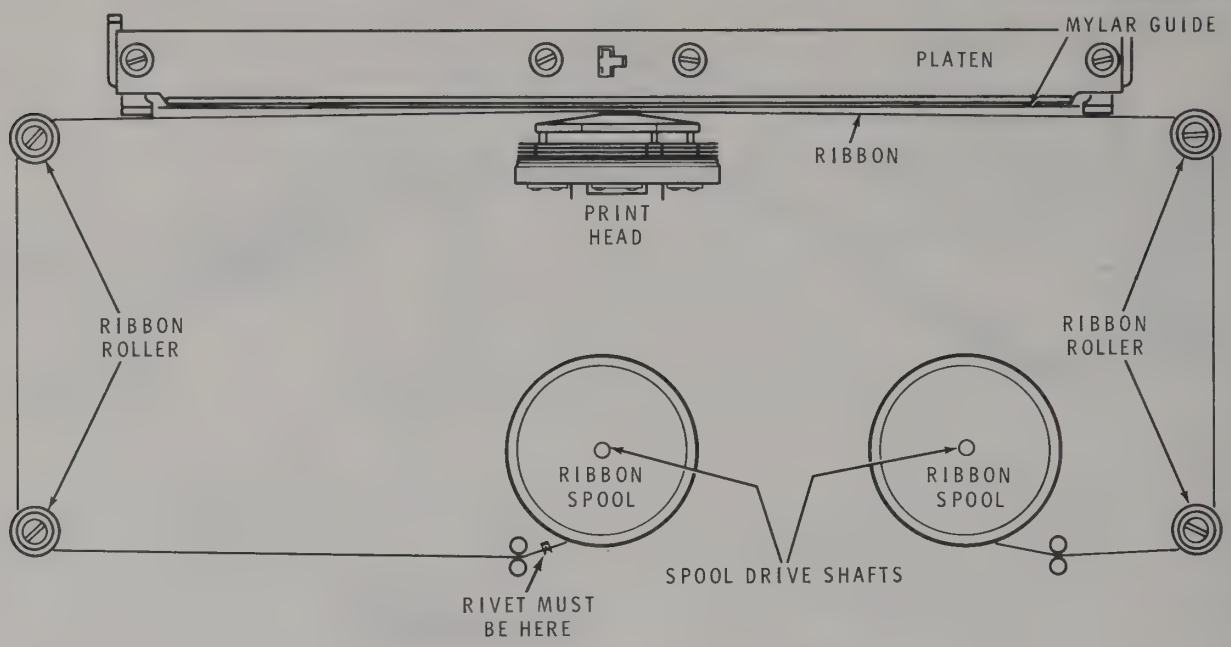
LINE FREQUENCY	SET SWITCH TO
60 Hz	1
50 Hz	Ø

LOADING PAPER

Feed the paper between the paper basket and the chassis. You can then use the basket to collect the printed paper. Be sure there are no sharp corners for paper to catch on, and do not allow a large amount of printed paper to pile up on the paper supply.

To load paper, refer to Pictorial 4 and:

1. Lift the top cover.
2. Open the paper hold-downs by lifting them away from the center of the paper.
3. Place the paper as shown and feed it through the opening at the rear of the top cover, under the paper guide, and between the ribbon and platen. NOTE: Using multiple-copy forms is not recommended.
4. Place the sprocket holes of the paper onto the left-hand sprocket and close the paper hold-downs.
5. If necessary, adjust the sprocket spacing on the drive shaft by loosening the knurled thumbscrew and sliding the right sprocket and paper hold-down assembly sideways on the shaft to a position which matches the sprocket holes in the paper. Then retighten the thumbscrew. Close the right paper hold-down.



PICTORIAL 5

PAGE LENGTH

When power is turned on, the Printer sets the form depth to 11 inches. To modify the form depth:

1. Press the ON LINE switch to the OUT ("off line") position.
2. Press in and hold the TOP FORM switch.
3. Use the FEED FWD switch and advance the form to the desired length.
4. Release the TOP FORM switch.
5. Press the ON LINE switch to the IN position.

The form depth has now been reset.

RIBBON INSTALLATION

To install a ribbon:

1. Turn off the Printer.
2. Refer to Pictorial 5 and manually move the print head to the approximate center of the platen.
3. Remove the old ribbon by lifting the two spools from the two spool drive shafts and pulling the ribbons from the mechanism.
4. Place a new ribbon on the spool drive shafts and thread it as shown.

PAPER OUT/JAMMED DETECTOR

If the Printer is out of paper or the paper is jammed, all printing will stop. This detector is active only when the Printer is "on line" and requires approximately one inch of "would be" paper travel before detection.

To reset the Printer, push the ON LINE switch to the OUT position and then to the IN position.

TEST

Section 4 of switch SW102 is in parallel with TEST switch SW101 and will cause continuous test lines to be printed when in the "0" position. Momentarily touching TEST switch SW101 will cause only one line of test data to be printed.

Use Test switch SW101 to check for print alignment on the form. Use switch SW102 for troubleshooting. Both switches are active only when the Printer is "off line."

AUTOMATIC LINE FEED

When section 3 of switch SW102 is in the "0" position, a line feed will be internally generated after a carriage return. With this switch in the "1" position, it will be necessary to give a line feed or form feed to advance the paper. In either case, a line feed or form feed will generate a carriage return. This switch is sampled only during power-up. The "1" position is recommended for Heath systems.

PROGRAMMING INFORMATION

The following control codes are recognized and executed by the Printer. All other control codes are disregarded.

LF — (Line Feed) Causes the paper to be advanced one line. It also performs the CR (carriage return) function prior to advancing the paper.

FF — (Form Feed) Causes carriage return functions; then it advances the paper to the head of the next form.

CR — (Carriage Return) Causes the data which has been entered prior to this command to be printed. If auto line feed has been selected by SW102, the paper will advance to the next line.

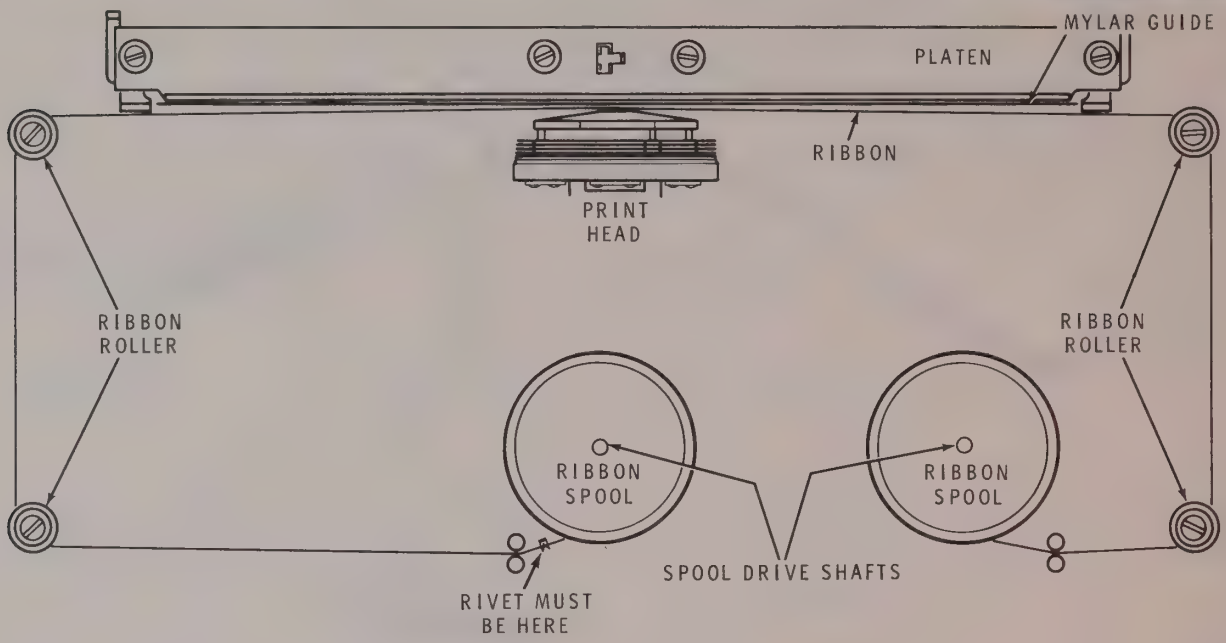
ESC, lower case u — (Change column width) The code to change to a new column width (which changes the width of each character) is shown in Chart 1.

DECIMA VALUE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

CHART 1

WIDTH CODE	SWITCH POSITION		WIDTH CODE	
	WIDE (characters/line)	NARROW (characters/line)	DECIMAL values	OCTAL values
ESC u CTL-A	80	80	27 117 1	033 165 001
ESC u CTL-D	80	96	27 117 4	033 165 004
ESC u CTL-H	80	132	27 117 8	033 165 010
ESC u CTL-P	96	80	27 117 16	033 165 020
ESC u CTL-T	96	96	27 117 20	033 165 024
ESC u CTL-X	96	132	27 117 24	033 165 030
ESC u SPACE	132	80	27 117 32	033 165 040
ESC u $	132	96	27 117 36	033 165 044
ESC u (	132	132	27 117 40	033 165 050



PICTORIAL 5

PAGE LENGTH

When power is turned on, the Printer sets the form depth to 11 inches. To modify the form depth:

1. Press the ON LINE switch to the OUT ("off line") position.
2. Press in and hold the TOP FORM switch.
3. Use the FEED FWD switch and advance the form to the desired length.
4. Release the TOP FORM switch.
5. Press the ON LINE switch to the IN position.

The form depth has now been reset.

RIBBON INSTALLATION

To install a ribbon:

1. Turn off the Printer.
2. Refer to Pictorial 5 and manually move the print head to the approximate center of the platen.
3. Remove the old ribbon by lifting the two spools from the two spool drive shafts and pulling the ribbons from the mechanism.
4. Place a new ribbon on the spool drive shafts and thread it as shown.

PAPER OUT/JAMMED DETECTOR

If the Printer is out of paper or the paper is jammed, all printing will stop. This detector is active only when the Printer is "on line" and requires approximately one inch of "would be" paper travel before detection.

To reset the Printer, push the ON LINE switch to the OUT position and then to the IN position.

TEST

Section 4 of switch SW102 is in parallel with TEST switch SW101 and will cause continuous test lines to be printed when in the "0" position. Momentarily touching TEST switch SW101 will cause only one line of test data to be printed.

Use Test switch SW101 to check for print alignment on the form. Use switch SW102 for troubleshooting. Both switches are active only when the Printer is "off line."

AUTOMATIC LINE FEED

When section 3 of switch SW102 is in the "0" position, a line feed will be internally generated after a carriage return. With this switch in the "1" position, it will be necessary to give a line feed or form feed to advance the paper. In either case, a line feed or form feed will generate a carriage return. This switch is sampled only during power-up. The "1" position is recommended for Heath systems.

PROGRAMMING INFORMATION

The following control codes are recognized and executed by the Printer. All other control codes are disregarded.

LF — (Line Feed) Causes the paper to be advanced one line. It also performs the CR (carriage return) function prior to advancing the paper.

FF — (Form Feed) Causes carriage return functions; then it advances the paper to the head of the next form.

CR — (Carriage Return) Causes the data which has been entered prior to this command to be printed. If auto line feed has been selected by SW102, the paper will advance to the next line.

ESC, lower case u — (Change column width) The code to change to a new column width (which changes the width of each character) is shown in Chart 1.

CHART 1

WIDTH CODE	SWITCH POSITION		WIDTH CODE	
	WIDE (characters/line)	NARROW (characters/line)	DECIMAL values	OCTAL values
ESC u CTL-A	80	80	27 117 1	033 165 001
ESC u CTL-D	80	96	27 117 4	033 165 004
ESC u CTL-H	80	132	27 117 8	033 165 010
ESC u CTL-P	96	80	27 117 16	033 165 020
ESC u CTL-T	96	96	27 117 20	033 165 024
ESC u CTL-X	96	132	27 117 24	033 165 030
ESC u SPACE	132	80	27 117 32	033 165 040
ESC u $	132	96	27 117 36	033 165 044
ESC u (	132	132	27 117 40	033 165 050

DECIMAL VALUE	ASCII WORD	MNEMONIC	DESCRIPTION	DECIMAL VALUE	ASCII WORD	MNEMONIC	DESCRIPTION
0	000 0000	NUL	Null	64	100 0000	@	At Sign
1	000 0001	SOH	Start of Heading	65	100 0001	A	Letter A
2	000 0010	STX	Start of Text	66	100 0010	B	Letter B
3	000 0011	EXT	End of Text	67	100 0011	C	Letter C
4	000 0100	EOT	End of Transmission	68	100 0100	D	Letter D
5	000 0101	ENQ	Enquiry	69	100 0101	E	Letter E
6	000 0110	ACK	Acknowledge	70	100 0110	F	Letter F
7	000 0111	BEEP	Bell	71	100 0111	G	Letter G
8	000 1000	BS	Backspace	72	100 1000	H	Letter H
9	000 1001	HT	Horizontal Tabulation	73	100 1001	I	Letter I
10	000 1010	LF	Line Feed	74	100 1010	J	Letter J
11	000 1011	VT	Vertical Tabulation	75	100 1011	K	Letter K
12	000 1100	FF	Form Feed	76	100 1100	L	Letter L
13	000 1101	CR	Carriage Return	77	100 1101	M	Letter M
14	000 1110	SO	Shift Out	78	100 1110	N	Letter N
15	000 1111	SI	Shift In	79	100 1111	O	Letter O
16	001 0000	DLE	Data Link Escape	80	101 0000	P	Letter P
17	001 0001	DC1	Device Control 1	81	101 0001	Q	Letter Q
18	001 0010	DC2	Device Control 2	82	101 0010	R	Letter R
19	001 0011	DC3	Device Control 3	83	101 0011	S	Letter S
20	001 0100	DC4	Device Control 4	84	101 0100	T	Letter T
21	001 0101	NAK	Negative Acknowledge	85	101 0101	U	Letter U
22	001 0110	SYN	Synchronous Idle	86	101 0110	V	Letter V
23	001 0111	ETB	End of Transmission Block	87	101 0111	W	Letter W
24	001 1000	CAN	Cancel	88	101 1000	X	Letter X
25	001 1001	EM	End of Medium	89	101 1001	Y	Letter Y
26	001 1010	SUB	Substitute	90	101 1010	Z	Letter Z
27	001 1011	ESC	Escape	91	101 1011	[	Open Brackets
28	001 1100	FS	File Separator	92	101 1100	\	Reverse Slash
29	001 1101	GS	Group Separator	93	101 1101	]	Close Brackets
30	001 1110	RS	Record Separator	94	101 1110	^	Up Arrow/ Caret
31	001 1111	US	Unit Separator	95	101 1111	_	Underscore
32	010 0000	SP	Space	96	110 0000	`	Open Quote
33	010 0001	!	Exclamation Point	97	110 0001	a	Letter a
34	010 0010	"	Quotation Marks	98	110 0010	b	Letter b
35	010 0011	#	Number Sign	99	110 0011	c	Letter c
36	010 0100	$	Dollar Sign	100	110 0100	d	Letter d
37	010 0101	%	Percent Sign	101	110 0101	e	Letter e
38	010 0110	&	Ampersand	102	110 0110	f	Letter f
39	010 0111	'	Apostrophe	103	110 0111	g	Letter g
40	010 1000	(	Open Parenthesis	104	110 1000	h	Letter h
41	010 1001	)	Close Parenthesis	105	110 1001	i	Letter i
42	010 1010	*	Asterisk	106	110 1010	j	Letter j
43	010 1011	+	Plus Sign	107	110 1011	k	Letter k
44	010 1100	,	Comma	108	110 1100	l	Letter l
45	010 1101	-	Hyphen/Minus Sign	109	110 1101	m	Letter m
46	010 1110	.	Period	110	110 1110	n	Letter n
47	010 1111	/	Slash	111	110 1111	o	Letter o
48	011 0000	0	Number 0	112	111 0000	p	Letter p
49	011 0001	1	Number 1	113	111 0001	q	Letter q
50	011 0010	2	Number 2	114	111 0010	r	Letter r
51	011 0011	3	Number 3	115	111 0011	s	Letter s
52	011 0100	4	Number 4	116	111 0100	t	Letter t
53	011 0101	5	Number 5	117	111 0101	u	Letter u
54	011 0110	6	Number 6	118	111 0110	v	Letter v
55	011 0111	7	Number 7	119	111 0111	w	Letter w
56	011 1000	8	Number 8	120	111 1000	x	Letter x
57	011 1001	9	Number 9	121	111 1001	y	Letter y
58	011 1010	:	Colon	122	111 1010	z	Letter z
59	011 1011	;	Semicolon	123	111 1011	{	Left Brace
60	011 1100	<	Less Than	124	111 1100	\|	Vertical Bar (broken)
61	011 1101	=	Equal Sign	125	111 1101	}	Right Brace
62	011 1110	>	Greater Than	126	111 1110	~	Tilde
63	011 1111	?	Question Mark	127	111 1111	DEL	Delete (rub out)

This setting will remain until power down or until it is changed through one of the above software commands. The width of characters cannot be changed within a line.

When you change the width by using a console terminal escape code, type the code with no spaces. Example: To type ESC u CTL-A; press the escape key (ESC), press the u key, and then push down the control (CTL) and shift keys and strike an a.

ESC, lower case x — (Set line spacing to 6 lines per inch) This is the normal line spacing, which will be activated upon power up. Use this code to return to this normal spacing after modifying the spacing to 8 lines per inch by a previous software command.

ESC, lower case y — (Set line, spacing to 8 lines per inch) This code, when received, will cause the printed lines to be spaced to 8 lines per inch.

Print Controls

(For proper operation, shaded commands should not be sent to the Printer except as part of the ESC-u sequence as described above.)

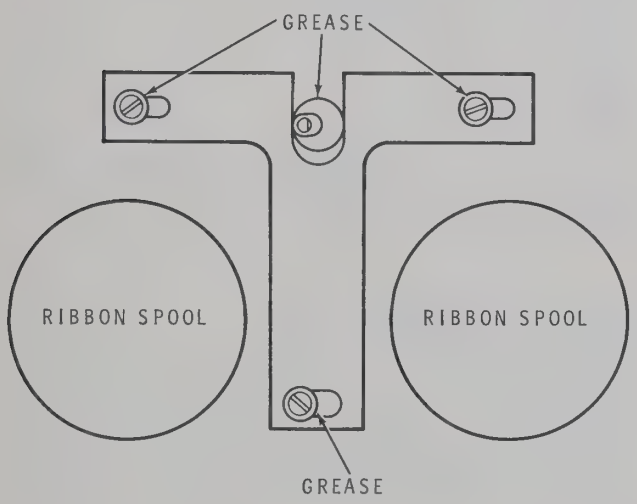
NOTE: When you operate your Printer, the paper drive motor may appear to become excessively warm. This condition is normal.

MAINTENANCE

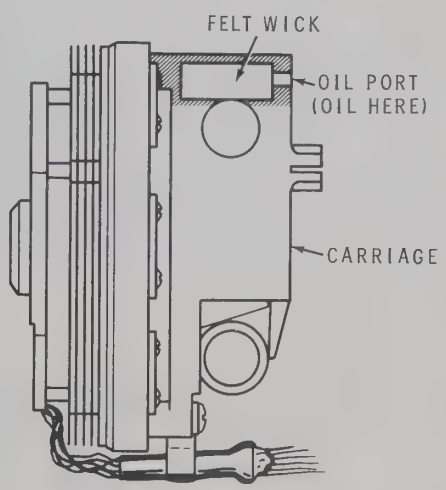
After each 100 hours of operation (1 carton of paper) grease the ribbon mechanism at the points shown in Pictorial 6. Use a light grease such as Heath grease, part number 352-14.

At this time, also clean any accumulation of dust and dirt from the head support shafts, head cooling fins, and the curved area between the paper guide and chassis near the paper out detector (left end of guide).

After each 500 hours of operation (5 cartons of paper), oil the head carriage as shown in Pictorial 7. Use a high grade light machine oil.



PICTORIAL 6



PICTORIAL 7

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (on fold-in) as you read the following information.

Serial input signals are converted to TTL levels by U101 or U103 and applied to the UART (U105). (UART output signals are converted by U102 and U104 to either 20 mA or EIA output signals.) The UART changes the serial input signals to parallel data, generates programmable baud rates and other control signals, and applies its data to the CPU (U106). The CPU (as controlled by the clock; crystal Y101 and gates U108A, B, and D) controls all the timing and command functions of the Printer and has an internal ROM which contains the complete operating program. The outputs from the CPU are applied through buffers U114, U115, and U116 to the print head drive circuits and the motor drive circuits. Input buffers U109 and U110 allow the sensing of the various switches and detectors, and U117 senses the print head temperature and keeps it from overheating.

INPUTS/OUTPUTS

20 mA serial input signals are applied to optical coupler U101. U101 changes the signals to TTL levels and applies the signals to the UART. This loop is isolated from ground when used in its passive mode and supplies 20 mA of current when used in its active mode.

EIA input signals are converted to TTL levels by U103. U102 converts TTL output signals into 20 mA loop signals and U104 converts TTL output signals into EIA output signals.

UART

The UART is a programmable device that is controlled by microcontroller U106. It uses the 2 MHz clock signal from divider U107 and generates selected baud rates by its internal programmable divider. After receiving a serial character, the UART sends a signal to the microcontroller. The microcontroller will then finish any timing that it is doing and take the input character. The character is then loaded into the line buffer RAM (U112 and U113).

ADDRESS LATCH

The address latch (U111) holds the RAM address or the UART control bus address while information is being entered or retrieved by the microcontroller.

MICROCONTROLLER (CPU)

All the control functions of the Printer are controlled by integrated circuit microcontroller (U106). This IC has its own internal ROM and programmable timer. The ROM contains the complete operating program and character font, and the timer performs all the timing functions of the Printer. The microcontroller also has four, 8-bit, I/O ports. Two ports drive the seven head solenoids, head drive motor, ribbon drive motor, and paper drive stepper motor; one port is a printer data bus; and one port is a device select port.

PRINT HEAD DRIVERS

Because the seven driver circuits are identical, only one driver circuit will be described.

Buffer U114D is an open collector TTL inverter. It interfaces the microcontroller output with driver transistor Q103. With logic "1" on the input of U114D, its output will be less than 0.4 volts. This turns Q103 off, which in turn, turns Q104 off. A logic "0" at the input of U114D turns on Q103 and Q104, and current flows through the print head solenoid. Diodes ZD101 and D103 provide arc suppression. ZD101 also makes the solenoid current decay more quickly by forcing the solenoid voltage to reach several volts before it zeners. Current peaks are supplied by capacitor C4.

HEAD AND RIBBON MOTOR DRIVERS

Because the three drivers are identical, only one of them will be described.

A logic "1" at the input of U115A causes its output to be held at less than 0.4 volts. This causes diode D111 to be off, no gate current flows in triac Q117, so Q117 is off or turns off when the motor current goes through zero. With a logic "0" at the input of U115A, its output goes high. This allows current to flow through D111 to the gate of Q117 and turn it on. Capacitor C109 makes Q117 less susceptible to noise pulses.

PAPER MOTOR DRIVERS

Again, because the four drivers are identical, only one of them will be described.

A logic "1" at the input of U116B causes its output to be a logic "0". Its output is connected to the input of U203E, which causes the output of U203E to be high. This allows current to flow in the emitter-base circuit of Q204, turning it on. When a "0" is input to U116B, the logic levels are reversed and Q204 turns off. D204 is used for arc suppression.

Inputs to U201D and U201A are always complements of each other. Whenever the inputs change state, one of the inputs to U201D or A is delayed by the R/C circuit (R203/C201 or R205/C202). This delay causes the inputs to be the same for a short time. When this occurs, a pulse is output from U201D or A. These pulses are coupled to U202 by U201C. U202 is a retriggerable, one-shot multivibrator with a time constant of 10 milliseconds.

The signal from U202 is coupled to U203F, which turns on Q205. Q205 supplies 35 volts to the paper drive motor when it is required to turn. R216 and R217 limit the current to the motor. The operation of U203F, Q206, and Q205 is identical to the head drivers.

D205 supplies a holding current to the paper drive motor while the motor is at rest.

PRINT HEAD TEMPERATURE CONTROL

U117A and B are comparators which are configured to measure the resistance of the copper winding of a print head solenoid. The temperature coefficient of copper wire is approximately 0.4%/°C. Therefore, this method is very effective in determining the solenoid temperature.

The temperature is sensed in two levels. When the first level is exceeded, U117A's output will change to a "0" logic level. This signal is connected to the microcontroller through U109 and is tested during the time the head is returning home. If the head temperature continues to rise due to high ambient temperatures or very dense printing, U117B will be triggered and the controller will cause printing to stop and LED2 (High Temp lamp on the front panel) will light continuously. Note: It is normal for this lamp to flicker during active printing.

The voltage which the comparators are referenced to appears across a precision voltage divider formed by R191 through R194. The head solenoid is placed in series with R189 and R195 across the same supply as divider R191 through R194. This makes the circuit insensitive to supply changes. To calibrate this circuit, the comparator reference is temporarily connected to a point in the divider string which corresponds to the cold resistance of the head solenoid. The current through this solenoid is adjusted by R195 to produce a voltage across it which is equal to the calibration reference. This is indicated by High Temp lamp LED2.

PAPER OUT/JAM DETECTOR

LED3 and Q2 form an optical switch. LED3 is on one side of the paper and Q2 is on the other side, and in line with the sprocket holes. Therefore, Q2 changes state when a sprocket hole appears and detects that the paper is moving. The logic levels from Q2 are tested by U106 (the microprocessor) through input buffer U109. If a level change is not detected by the time the processor has output enough pulses to the paper drive stepper motor to move the paper approximately one inch, the processor stops all printing.

POWER SUPPLIES

35-Volt Head Supply

Full-wave bridge rectifier D118, D119, D121, and D122 supplies approximately 45 volts. Transistors Q1 and Q125 form a Darlington pair pass element. Transistors Q126 and Q127 form a differential amplifier which compares a portion of the 35-volt output to the 5-volt supply and drives the pass element to maintain the 35-volt output. Transistor Q124 senses an overcurrent condition and turns on when the voltage across R169 exceeds approximately 0.7 volts. This causes the differential amplifier to make the pass element conduct less and limits the current to a safe value.

+12 Volt

Diodes D123 and D125 full-wave rectify the current, and capacitor C2 filters it. The supply is unregulated.

−12 Volt

Diode D124 half-wave rectifies the current, and capacitor C113 filters it. The supply is unregulated.

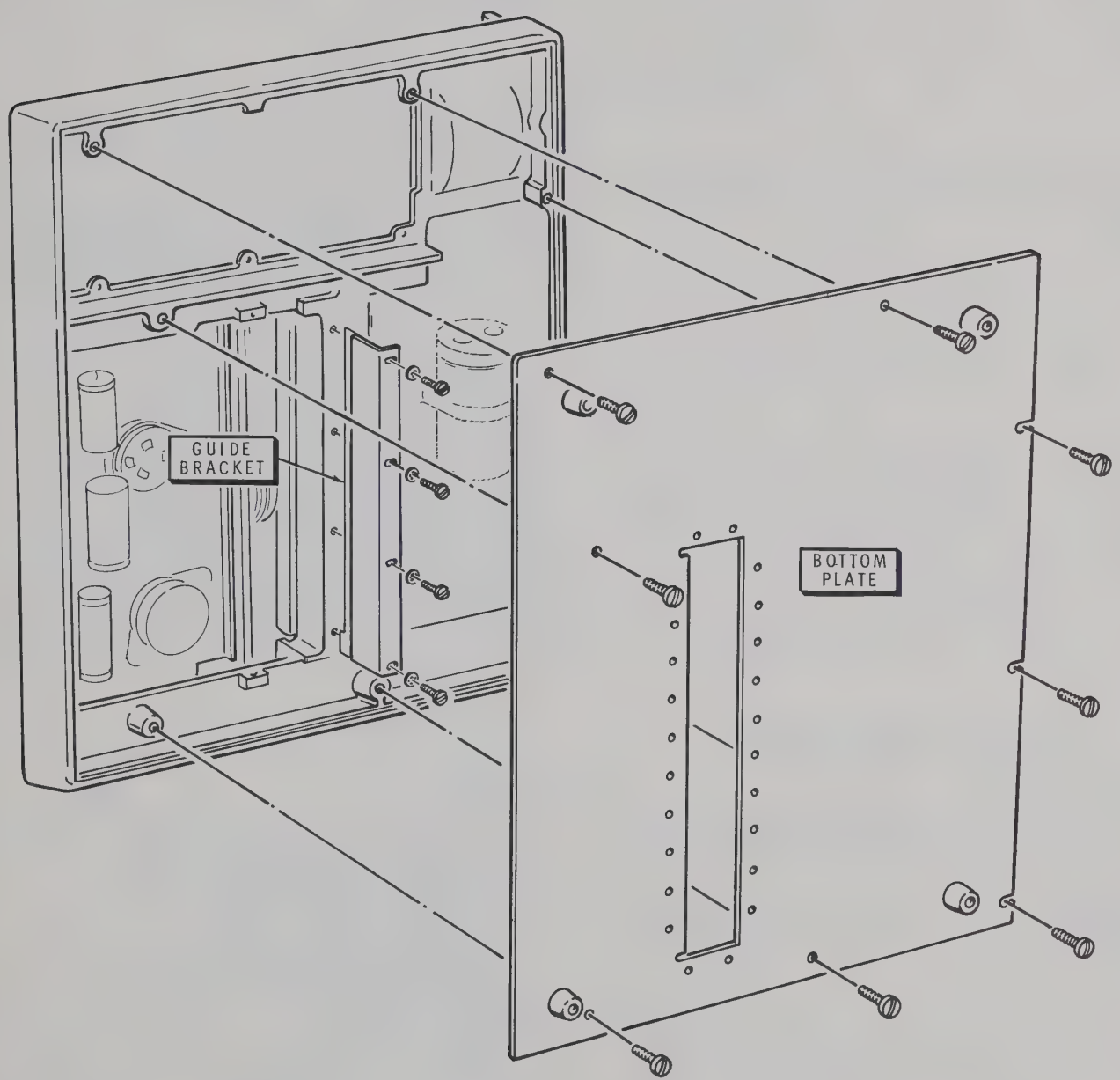
+5 Volt

U1 is a three-terminal device that changes the +12 volts to +5 volts and limits its output to one ampere.

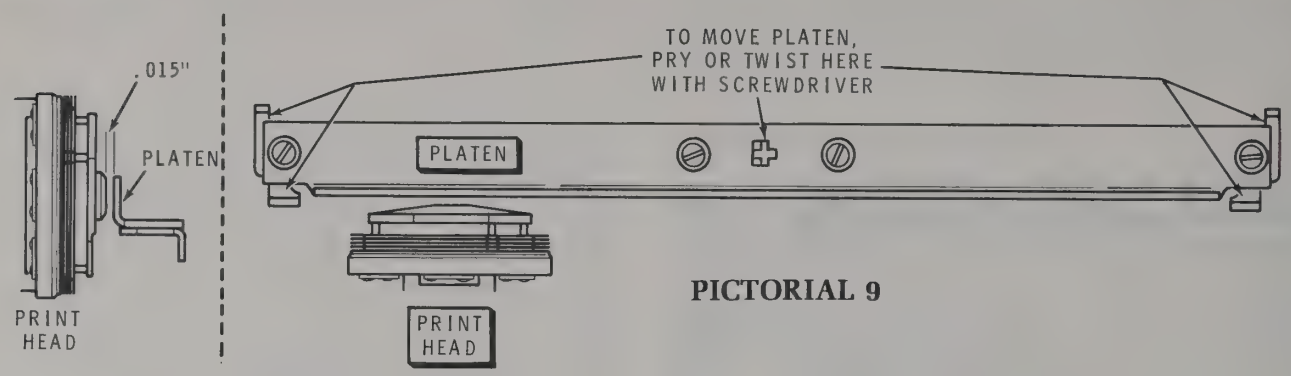
POWER UP/DOWN CIRCUIT

This circuit keeps power from being applied to the head and motor drive circuits until the 5-volt supply reaches 4.2 volts. Capacitor C125 delays the voltage on the base of transistor Q128 as the 5-volt supply comes up. The emitter of Q128 is held at 3.6 volts by ZD109. When the base voltage of Q128 exceeds 4.2 volts, Q128 turns on. This turns on Q129 and supplies 12 volts to the pullup resistors of the drive circuits. Then when the 5-volt supply drops below 4.2 volts at turnoff, Q128 quickly turns off and removes power from the pullup resistors.

RECALIBRATION



PICTORIAL 8



PICTORIAL 9

Electrical

Note: The print head should be at approximately 25°C (no printing should have been done for the previous one hour).

Remove the jumper from between J118 and J119 and place it from J117 to J118.

Turn the High Temp Adj control (R195) fully counterclockwise.

Turn on the POWER switch.

Slowly rotate control R195 clockwise until the HIGH TEMP front panel light comes on.

Turn off the POWER switch.

Replace the jumper between J118 and J119.

Mechanical (Head to Platen Spacing)

Remove the ribbon.

Refer to Pictorial 8 and remove the bottom plate.

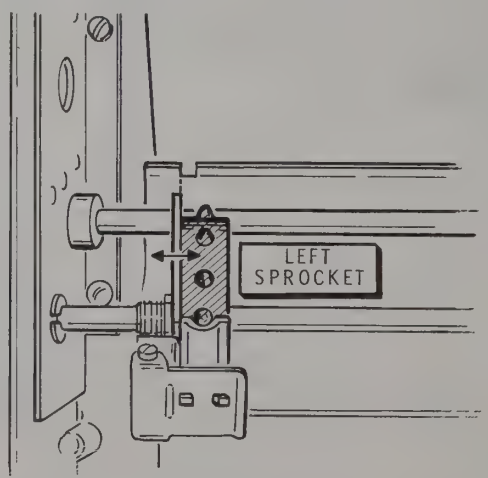
Remove the four 4-40 screws and the guide bracket they hold.

Loosen the four platen screws slightly but leave them still snug. (If necessary, first loosen the paper sprockets and slide them out of the way.) Move the print head sideways as necessary and insert the .015" feeler gauge between the nose of the print head and either end of the platen. (See Part A of Pictorial 9.) Use a screwdriver and adjust the platen. (See Part B of the Pictorial.) The feeler gauge should slide between the print head and platen, but there should be a slight drag on it.

As before, adjust the other end of the platen for .015".

Adjust the center of the platen of .015".

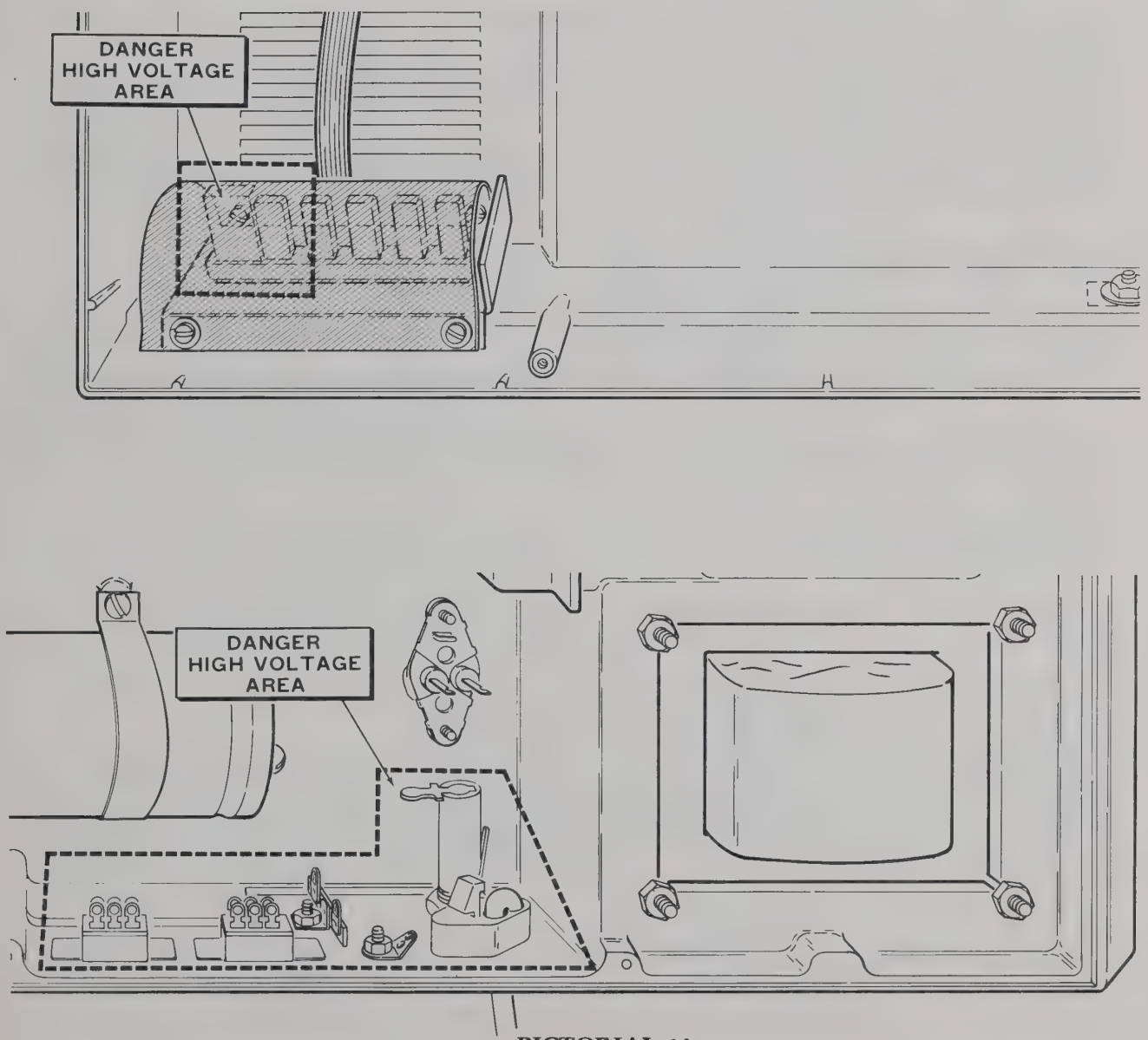
Recheck the three dimensions, tighten the platen screws, and replace the guide bracket and bottom plate. (If you loosened the paper sprockets, realign the left sprocket as shown in Pictorial 10. Adjust the right sprocket to the width of your paper.)



PICTORIAL 10

IN CASE OF DIFFICULTY

WARNING: When the line cord is connected to an AC outlet, hazardous voltages are present at several places inside your Printer. See Pictorial 11.



PICTORIAL 11

This section of the Manual is divided into three parts. The first part, titled "Troubleshooting and Repair Precautions," points out the care what you should use when you service the unit to prevent damaging components.

The second part, titled "Troubleshooting Chart" gives difficulties and likely causes.

The third part, titled "Step-by-Step Testing" gives you a systematic method of locating the problem.

If the "Step-by-Step Testing" does not help you locate the problem, read the "Circuit Description" and refer to the Schematic Diagram (fold-in) to help you determine where the trouble is.

Refer to the "Circuit Board X-Ray Views" Pages 29 and 30 for the physical location of parts on the circuit boards.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the raar cover of the Manual. Your warranty is also located inside the rear cover.

TROUBLESHOOTING AND REPAIR PRECAUTIONS

1. Make sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead slips, for example, and shorts together two adjacent connections, it is very likely to damage one or more of the transistors, diodes, or IC's.

2. Be especially careful when you test any circuit that contains an IC or a transistor. Although these components have an almost unlimited life when used properly, they are much more vulnerable to damage from excess voltage and current than many other parts.

3. Do not remove any components while the unit is turned on.

4. Use a voltmeter with a high input impedance when you measure voltages.

5. Never apply +5 volts or ground potentials to the output of any IC.

6. When you make repairs, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, be sure you find out what damaged the resistor. If the cause is not eliminated, the replacement resistor may also become damaged when you put the unit back into operation.

7. In several areas of the circuit boards, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool (or solder braid) makes part removal easier.

COMPONENTS

To remove faulty resistors or capacitors; first clip them from their leads, then heat the solder on the foil and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the holes in the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

You can remove transistors in the same manner as resistors and capacitors. Make sure you install the replacement transistor with its leads in the proper holes. Then solder the leads quickly to avoid heat damage. Cut off the excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, bridge solder across the break. Bridge large gaps in the foil with bare wire. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.

TROUBLESHOOTING CHART

The following chart lists conditions and possible causes of several specific malfunctions. If a particular part is mentioned (Q7 for example) as a possible cause, check that part and other components connected to that part to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

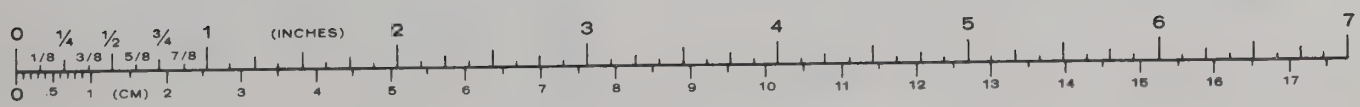
PROBLEM	POSSIBLE CAUSE
Printer completely dead. Power lamp not lit.	1. No power at wall outlet, line cord. 2. SW1, F1, T1, D123, D125.
Printer completely dead. Power lamp lit.	1. U1, Q128, Q129, U108, U106. 2. Printer "on line" with no signal received.
Head moves normally, but does not print.	1. F101, Q1, Q125, Q126, Q127, Q124. 2. D118, D119, D121, D122, U106.
Upon power up, head moves to the right; then returns to left-hand stop, motor keeps running (clutch slipping).	1. Q3, U109, U106. 2. Motor lead connections.
Upon power up, head moves to the right and then stops. Does not return to left margin.	1. Q3, U109, U106, U115A, Q117, D111. 2. Head motor.
Top row of dots missing in printed characters. 	1. U114D, U106, Q103, Q104. 2. Print head.
Second row of dots missing in printed characters. 	1. U114E, U106, Q105, Q106. 2. Print head.
Third row of dots missing in printed characters. 	1. U114F, U106, Q107, Q108. 2. Print head.
Fourth row of dots missing in printed characters. 	1. U114C, U106, Q109, Q110. 2. Print head.
Fifth row of dots missing in printed characters. 	1. U114B, U106, Q111, Q112. 2. Print head.
Sixth row of dots missing in printed characters. 	1. U114A, U106, Q113, Q114. 2. Print head.
Bottom row of dots missing in printed characters. 	1. U115C, U106, Q115, Q116. 2. Print head.
Ribbon motor does not run, or runs when no active printing is being done.	1. U115B, U106, D113, Q119. 2. Ribbon drive motor. 3. Out of paper or head is hot and data is in buffer.
Print head does not move to the right at any time.	1. U115D, U106, Q118, D112. 2. Head motor.

Troubleshooting Chart (Cont'd.)

PROBLEM	POSSIBLE CAUSE
Head motor buzzes but head does not move in either direction.	1. C5. 2. Head motor.
Paper moves backwards.	1. Two windings on paper drive motor reversed (wiring).
Paper does not move, or moves erratically.	1. U115F, U116A, B, or F, Q201, Q202, Q203, Q204. 2. Improper gear mesh (motor gear to sprocket shaft). 3. Binding in area of sprocket shaft. 4. Paper drive motor. 5. U106.
Paper "Feed FWD" does not cause the paper to feed forward.	1. "On line,' switch depressed. 2. SW6. 3. U110.
Paper "Feed REV" does not cause the paper to move backwards 1 line width.	1. "On line" switch depressed. 2. SW7. 3. U110.
"Wide Char" switch does not change character width.	1. SW5, U109, U106. 2. Both sides of switch programmed the same.
5 or 6 lines are printed when "on line;" then printing stops. Paper supply is adequate and not jammed.	1. LED3, Q2, U109. 2. Incorrect alignment of left-hand paper drive sprocket to paper guide. 3. Paper too transparent.
Printer will not go "off line."	1. SW4, U109.
High Temp LED is on, Printer will not print, print head is cold.	1. Jumper from J118 to J119 is installed from J118 to J117 (calibrate position). 2. U117B. 3. Print head.
Test works but no printing is done "on line" connected to RS-232 source.	1. U103, U105. 2. Signal source and Printer on different baud rate. 3. Incorrect I/O wiring, no signal from source, defective I/O cable. 4. Jumper from J114 to J115 is connected between J113 and J114. 5. Printer is off line.
Operates properly with 110 baud signal, but loses characters when operating at higher baud rates.	1. U104, U105, (U102, Q101, Q102, 20 mA loop option). 2. Jumper between J109 and J110, or J110 and J111 in the incorrect position. 3. Signal source not recognizing the handshaking signals. Incorrect I/O wiring or defective cables.
Operates properly on RS-232 signals but does not operate on 20 mA loop signals.	1. U101. 2. Incorrect position of jumper between J113 and J114, or J114 and J115, both 20 mA loops setup for active or passive operation. 3. Incorrect I/O connection or defective cables.

Troubleshooting Chart (Cont'd.)

PROBLEM	POSSIBLE CAUSE
Some characters print correctly, others print incorrectly but consistent.	1. U111, U112, U113.
Characters are inconsistent and incorrect.	1. Baud rates set differently on source and Printer.
All dots in a character are not the same darkness top to bottom.	1. New print head (may require some running). 2. Bent platen. 3. Worn or dried ribbon.
Uneven character spacing.	1. Head motor clutch, head motor. 2. Q118, Q117. 3. Binding on head carriage or loose drive cable.
Characters are not of uniform darkness across a line.	1. Incorrect adjustment of platen to head spacing. 2. Bent platen or head support shafts. 3. Ribbon not in place. 4. Worn or dried ribbon.



STEP-BY-STEP TESTING

() Be sure the line cord is unplugged.

() Carefully remove U106 from its socket and set it aside.

() Unplug the print head plug from socket S101.

NOTE: In the following step, you will turn the Printer on and check for overheating of parts. If there is evidence of overheating, disconnect the power plug immediately and check for short circuits in the circuitry where the overheating occurred.

WARNING: When the line cord is plugged in, the full AC line voltage is present at the POWER switch.

() Plug the line cord into an AC outlet and push the POWER switch to the ON position.

IMPORTANT: When you prepare the test wires in the following steps, use the small solid wire supplied with your kit. Larger wire can damage the IC sockets.

() Remove 1/4″ of insulation from a 5″ wire. Then insert one end of the wire into the pin connector at J112.

If you have a voltmeter, complete the three following voltage tests.

() Connect the meter common lead to the 5″ wire. Leave the lead connected to the 5″ hookup wire for the three following voltage tests.

() Connect the voltmeter test lead to either lead of resistor R169 (.33 Ω, orange-orange-silver). The meter should read between 45 to 60 volts. If not, check D118, D119, D121, D122, C3, and the wiring of transformer T1.

() Connect the voltmeter test lead to either clip of fuse F101. The voltmeter should read between 32 to 38 volts DC. If not, check Q1, Q124, Q125, Q126, Q127, and U101 (5-volt supply).

() Connect the voltmeter test lead to pin 40 of socket U106. The voltmeter should read between 4.7 to 5.3 volts DC. If not, check C2, D123, D125 (12-volt supply), U101, and C115.

This completes the voltage tests. Disconnect the voltmeter.

() Momentarily connect the free end of the 5″ wire to pin 31 of socket U106. The print head should move from left to right. If not, check U115D, D118, D112, C5, T1, and the head motor.

() Momentarily connect the free end of the 5″ wire to pin 32 of socket U106. The print head should move from right to left. If not, check U115A, Q117, D111, C5, and the head motor.

() Momentarily connect the free end of the 5″ wire to pin 33 of socket U106. The ribbon motor should run. If not, check U115B, Q119, D113, T1, and the ribbon motor.

() Prepare an 11″ wire and insert one end into the pin connector at TP-101.

() Momentarily touch the free end of the 11″ wire to each of the metal tabs of Q201, Q202, Q203, and Q204. As you touch each tab, LED101 should not glow.

() Connect the free end of the 5″ hookup wire coming from J112 to pin 29 of U106; then connect the free end of the 11″ hookup wire to the collector (C) lead of Q203. LED101 should light. If it does not, check U115F and Q203.

() Connect the 5″ hookup wire to pin 28 of U106; then connect the 11″ hookup wire to the collector (C) lead of Q201. LED101 should light. If it does not, check U116F and Q201.

() Connect the 5″ hookup wire to pin 27 of U106; then connect the 11″ hookup wire to the collector (C) lead of Q202. LED101 should light. If it does not, check U116A and Q202.

() Connect the 5″ hookup wire to pin 26 of U106; then connect the 11″ hookup wire to the collector (C) lead of Q204. LED101 should light. If it does not, check U116B and Q204.

() Connect the free end of the 11″ hookup wire to pin 9 of print head socket S101. LED101 should not light. Then, with the 11″ hookup wire still connected, connect the free end of the 5″ hookup wire to pin 14 of U106. LED101 **should** light. If it does not, check U114D, Q103, and Q104.

Using the prodecure in the previous step, complete the steps in the following chart.

	CONNECT 11" WIRE TO S101 PIN (LED101 SHOULD NOT LIGHT)	THEN CONNECT 5" WIRE TO U106 PIN (LED101 SHOULD LIGHT)	POSSIBLE CAUSE IF LED101 LIGHTS
()	10	13	U114E, Q105, Q106
()	14	12	U114F, Q107, Q108
()	15	11	U114C, Q109, Q110
()	13	10	U114B, Q111, Q112
()	12	9	U114A, Q113, Q114
NOTE: Unsolder and disconnect one lead of R189 before you perform the following test. Then reconnect and resolder the resistor lead.			
()	11	8	U115C, Q115, Q116

() Remove the 11" hookup wire from TP101 and connect one end to TP102.

() Momentarily connect the free ends of the 5" and 11" hookup wires together and note the brightness of LED102. Now connect the 11" hookup wire to pin 16 of U105. LED102 should glow at a reduced brightness. If not, check U107, U108, and Y101.

() Connect the 5" wire to pin 37 of socket U106, connect the 11" wire to pin 16 of U106, and manually push the print head to the left. LED102 should not light. Then move the print head at least 2" to the right. LED102 should now light. If not, check U109 and Q3.

() Connect the 11" wire to socket U106 pin 5 (with the 5" wire still connected to U106 pin 37). LED102 should light. Now insert a piece of paper, with the sprocket holes removed, into the paper feed channel. Push the paper as far to the left as possible. LED102 should now go off. If it does not, check LED3, Q2, and U109.

() With the 5" wire still connected to pin 37 of socket U106, connect the 11" wire to pin 17 of U106 and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not, check U109 and SW4.

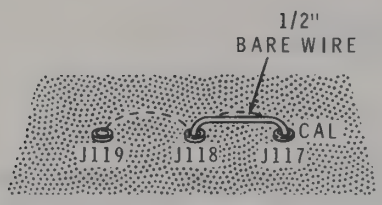
() Connect the 5" wire to pin 36 of socket U106, connect the 11" wire to pin 17 of U106, and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not, check U110 or SW4.

() With the 5" wire still connected to pin 36 of U106, connect the 11" wire to pin 19 of U106 and place section 4 of SW102 in the 1 position. LED102 should be off. Press TEST switch SW101; LED102 should light. If not, check U110, SW101, and SW102.

() Press the POWER switch to the OFF position.

() Turn R195 fully counterclockwise (CCW).

() Plug the print head plug into socket S101.



PICTORIAL 12

() Prepare a 1/2" bare wire. Refer to Pictorial 12 and install this wire between J118 and J117 on the circuit board.

() Press the POWER switch to the ON position. The HIGH TEMP indicator (LED102) on the front panel should be off. Slowly rotate R195 clockwise until the HIGH TEMP indicator lights.

() Press the POWER switch to the OFF position and reconnect the 1/2" bare wire between J118 and J119.

() Press the POWER switch to the ON position. The HIGH TEMP indicator should not light. If it does light, check U117, U116D, and U116E.

() Connect the 5" wire to pin 37 of socket U106. Then alternately connect the 11" wire to pin 3 and pin 4 of U106. LED102 should not light for either of these tests.

() Unplug the print head plug and repeat the tests in the previous step. Now LED102 should light for both tests. If not, check U109.

() Press the POWER switch to the OFF position.

() Remove the 5" and 11" wires.

() Reinstall the IC at U106.

() Set the top panel switches as follows:

POWER	OFF (out)
ON LINE	OFF (out)
WIDE CHAR	WIDE (out)

() Install the paper in your Printer.

() Press the POWER switch to the ON position. The print head should move from left to right for a short period of time; then it should return to the left margin and stop. If not, check U106.

() Press the TEST switch (SW101) momentarily. A line of test information should be printed. If not, check U106.

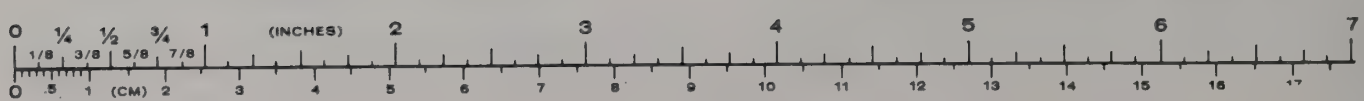
() Momentarily press the FEED FWD switch. The paper should move forward approximately .02 inches (one step). Then hold the FEED FWD switch down. The paper should continue to advance in full-line steps after a short delay. If not, check U109, U106, and SW6.

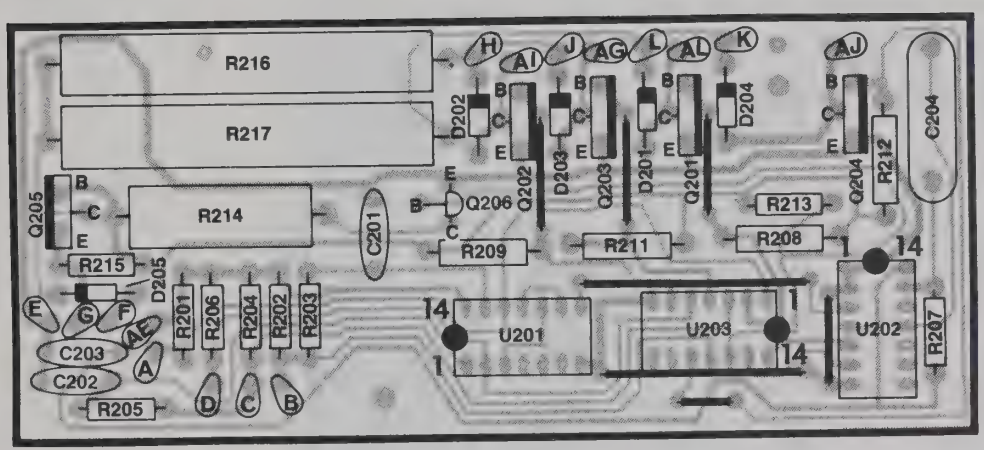
() Press the FEED REV switch. The paper should move back in the same mode as it moved forward. If not, check U106, U109, and SW7.

() Momentarily press the TOP FORM switch. The paper should advance 11". If not, check SW7, U110, and U106.

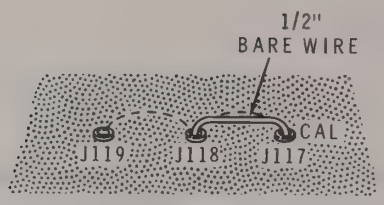
() Press the POWER switch to the OFF position.

This completes the Tests.





STEPPER DRIVER CIRCUIT BOARD
(Viewed from the component side.)



PICTORIAL 12

() Prepare a 1/2" bare wire. Refer to Pictorial 12 and install this wire between J118 and J117 on the circuit board.

() Press the POWER switch to the ON position. The HIGH TEMP indicator (LED102) on the front panel should be off. Slowly rotate R195 clockwise until the HIGH TEMP indicator lights.

() Press the POWER switch to the OFF position and reconnect the 1/2" bare wire between J118 and J119.

() Press the POWER switch to the ON position. The HIGH TEMP indicator should not light. If it does light, check U117, U116D, and U116E.

() Connect the 5" wire to pin 37 of socket U106. Then alternately connect the 11" wire to pin 3 and pin 4 of U106. LED102 should not light for either of these tests.

() Unplug the print head plug and repeat the tests in the previous step. Now LED102 should light for both tests. If not, check U109.

() Press the POWER switch to the OFF position.

() Remove the 5" and 11" wires.

() Reinstall the IC at U106.

() Set the top panel switches as follows:

POWER	OFF (out)
ON LINE	OFF (out)
WIDE CHAR	WIDE (out)

() Install the paper in your Printer.

() Press the POWER switch to the ON position. The print head should move from left to right for a short period of time; then it should return to the left margin and stop. If not, check U106.

() Press the TEST switch (SW101) momentarily. A line of test information should be printed. If not, check U106.

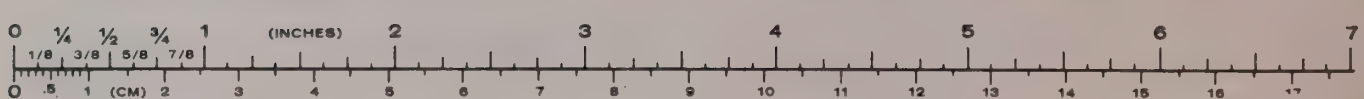
() Momentarily press the FEED FWD switch. The paper should move forward approximately .02 inches (one step). Then hold the FEED FWD switch down. The paper should continue to advance in full-line steps after a short delay. If not, check U109, U106, and SW6.

() Press the FEED REV switch. The paper should move back in the same mode as it moved forward. If not, check U106, U109, and SW7.

() Momentarily press the TOP FORM switch. The paper should advance 11". If not, check SW7, U110, and U106.

() Press the POWER switch to the OFF position.

This completes the Tests.



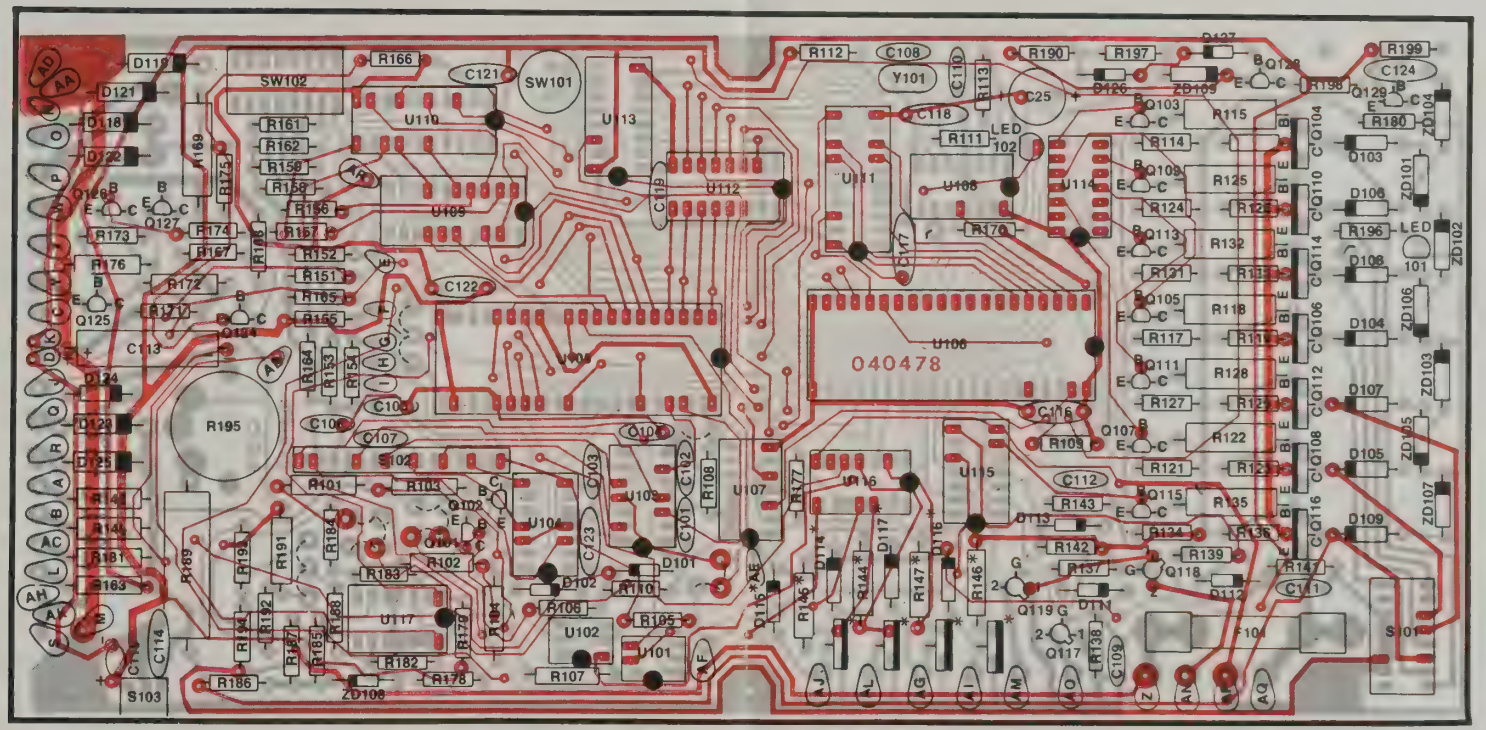
CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, C. etc.) on the X-Ray view.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



* These components are not installed in your circuit board.

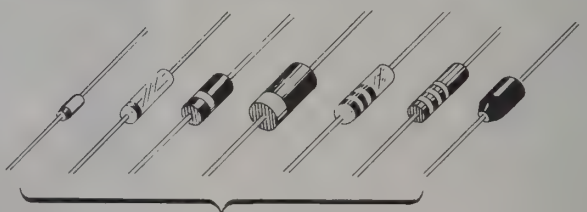
MAIN CIRCUIT BOARD
(Viewed from the component side.)

SEMICONDUCTOR IDENTIFICATION CHARTS

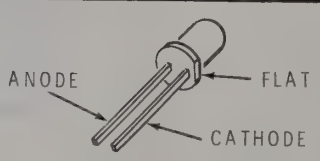
DIODES

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
ZD109	56-50	DO-7	
D101, D102, D111, D112, D113, D126, D127	56-56	1N4149	
ZD101, ZD102, ZD103, ZD104, ZD105, ZD106, ZD107	56-605	1N4746A	
ZD108	56-612	1N5229	
D118, D119, D121, D122, D123, D125	57-42	3A1	
D103, D104, D105, D106, D107, D108, D109, D114, D115, D116, D117, D124	57-65	1N4002	
LED1, LED2, LED101, LED102	412-616	FLV117	
LED3	412-635	TIL-32	

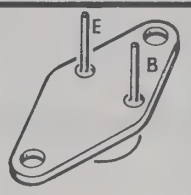
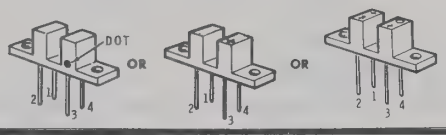
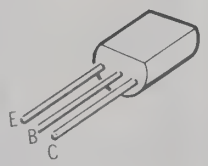
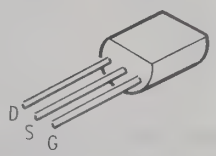
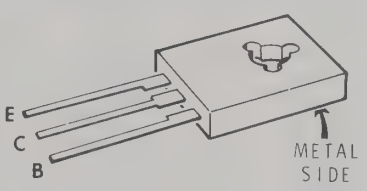
IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



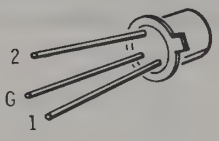
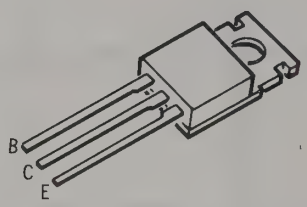
BANDED END



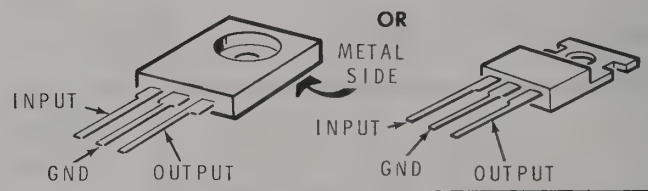
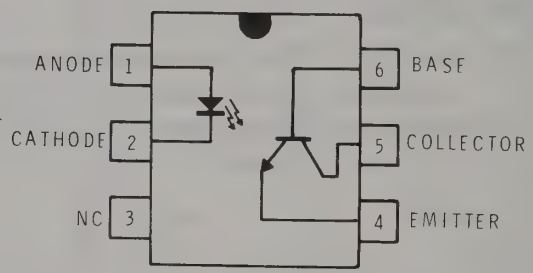
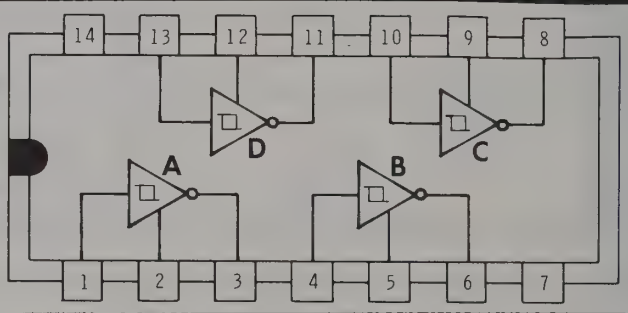
TRANSISTORS

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	417-892	MJE2941	
Q2	417-919	TIL-78	
Q3	150-74	Optron Inc. OPB813, Spectronics Inc. SPX1874-1, HEI Inc. EOS-2A1	
Q101, Q124, Q125, Q129	417-865	MPSA55	
Q103, Q105, Q107, Q109, Q111, Q113, Q115, Q126, Q127, Q206	417-864	MPSA05	
Q128	417-801	MPS801	
Q102	417-897	Selected	
Q104, Q106 Q108, Q110, Q112, Q114, Q116, Q205	417-263	SIE607	

Transistors (Cont'd.)

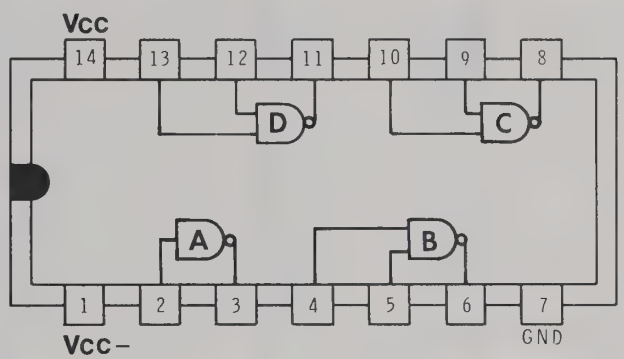
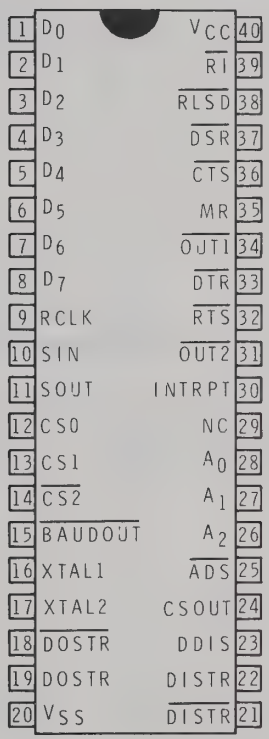
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q117, Q118, Q119	57-612	T2302F or H103SG	
Q201, Q202, Q203, Q204	417-852	TIP-31	

INTEGRATED CIRCUITS

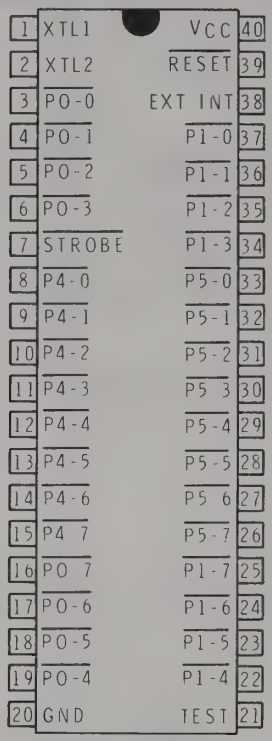
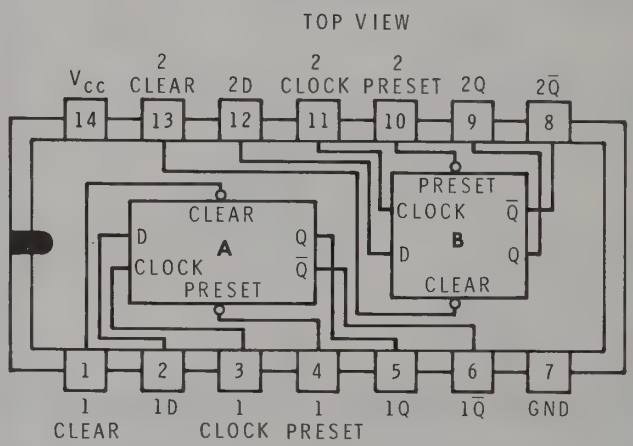
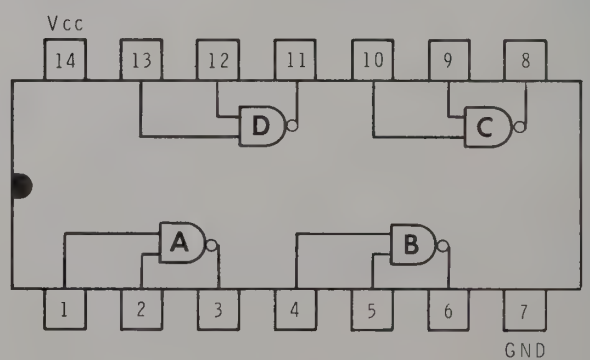
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U1	442-54	7805	
U101, U102	443-808	4N26	
U103	443-795	75189 or 7489	

HEATHKIT®

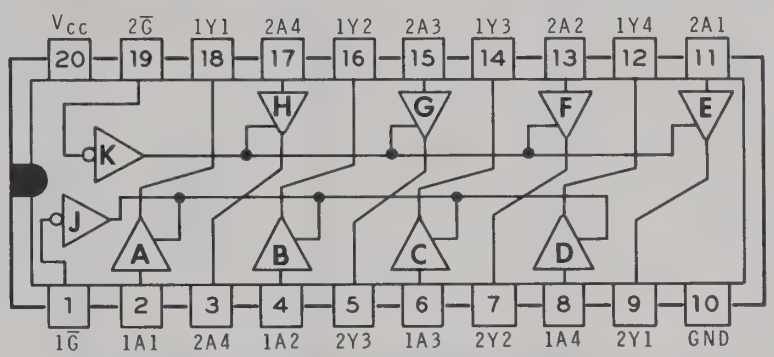
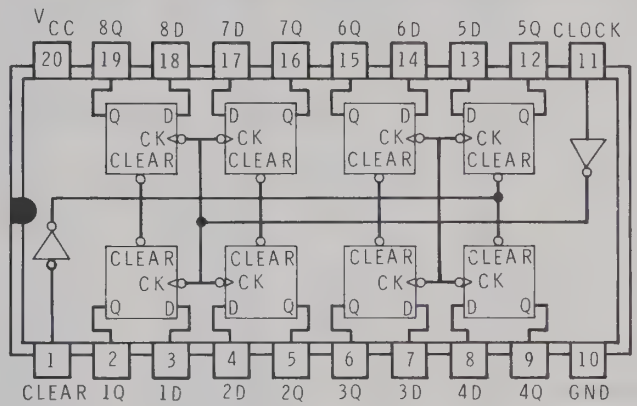
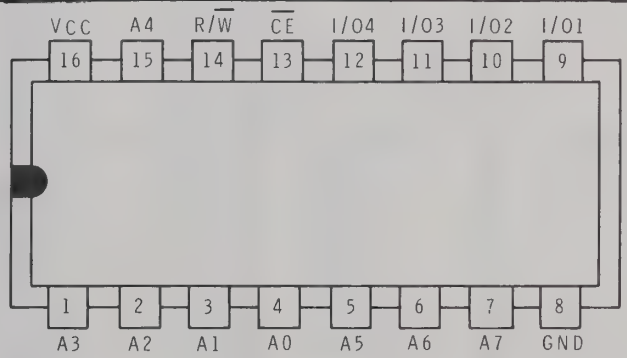
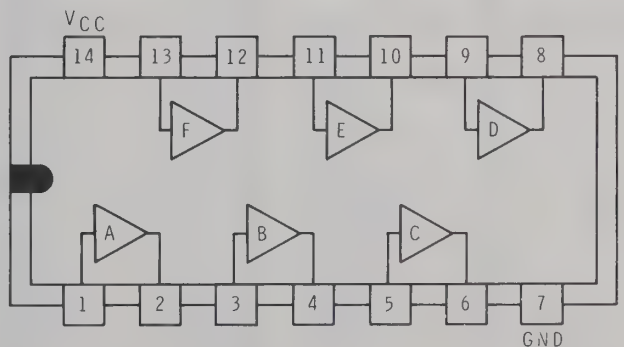
Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U104	443-794	75188 or 1488	
U105	443-874	8250	

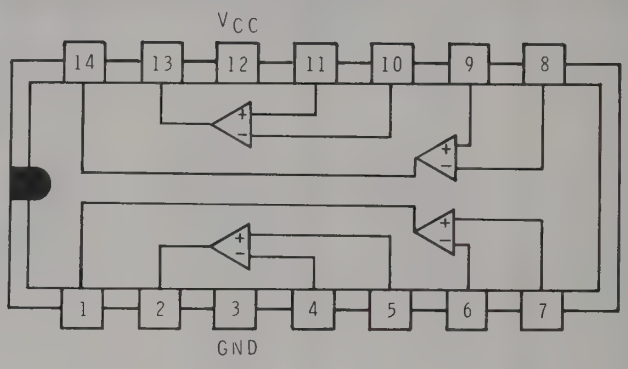
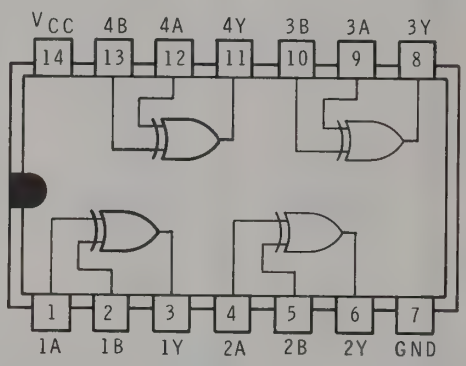
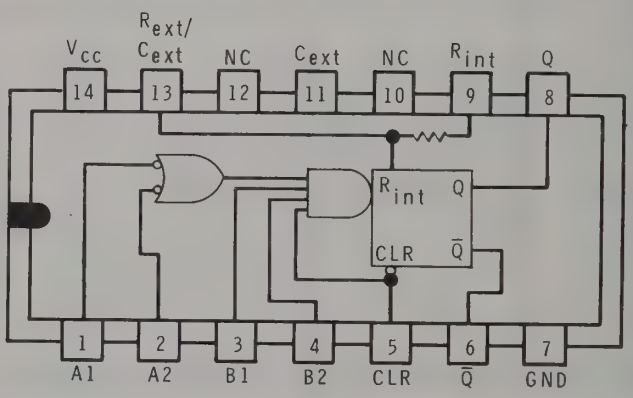
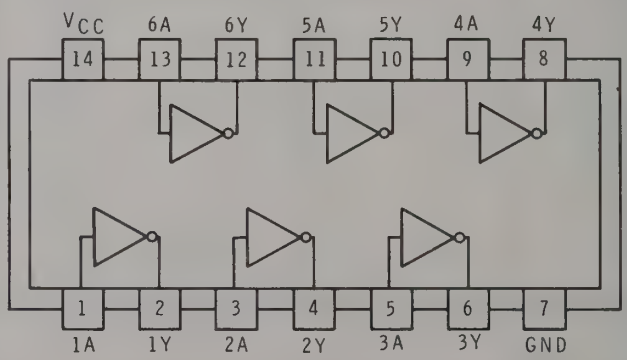
Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U106	444-31	3870 (available only from Heath Co.)	
U107	443-6	7474	 IC126
U108	443-728	74LS00	

Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U109, U110	443-791	74LS244	
U111	443-805	74LS273	
U112, U113	443-721	2112-2	
U114, U115, U116	443-73	7416	

Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U117	442-616	LM3302, LM2901, μA775 (selected)	
U201	443-698	7486N	
U202	443-23	74122	
U203	443-73	7416N	

PARTS LIST

RESISTORS

All resistors are 1/4-watt, 5% unless marked otherwise.

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R101	6-471	470 Ω, 1/2-watt
R102	6-471	470 Ω, 1/2-watt
R103	6-471	470 Ω, 1/2-watt
R104	6-471	470 Ω, 1/2-watt
R105	6-272-12	2700 Ω
R106	6-683-12	68 kΩ
R107	6-471	470 Ω, 1/2-watt
R108	6-122-12	1200 Ω
R109	6-122-12	1200 Ω
R110	6-221-12	220 Ω
R111	6-561-12	560 Ω
R112	6-122-12	1200 Ω
R113	6-122-12	1200 Ω
R114	6-122-12	1200 Ω
R115	6-331-1	330 Ω, 1-watt, 10%
R116	6-122-12	1200 Ω
R117	6-122-12	1200 Ω
R118	6-331-1	330 Ω, 1 watt, 10%
R119	6-122-12	1200 Ω
R120	NOT USED	
R121	6-122-12	1200 Ω
R122	6-331-1	330 Ω, 1-watt, 10%
R123	6-122-12	1200 Ω
R124	6-122-12	1200 Ω
R125	6-331-1	330 Ω, 1-watt, 10%
R126	6-122-12	1200 Ω
R127	6-122-12	1200 Ω
R128	6-331-1	330 Ω, 1-watt, 10%
R129	6-122-12	1200 Ω
R130	NOT USED	
R131	6-122-12	1200 Ω
R132	6-331-1	330 Ω, 1-watt, 10%
R133	6-122-12	1200 Ω
R134	6-102-12	1200 Ω
R135	6-331-1	330 Ω, 1-watt, 10%
R136	6-122-12	1200 Ω

Resistors (Cont'd.)

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R137	6-681-12	680 Ω
R138	6-222-12	2200 Ω
R139	6-681-12	680 Ω
R140	NOT USED	
R141	6-222-12	2200 Ω
R142	6-681-12	680 Ω
R143	6-222-12	2200 Ω
R144	NOT USED	
R145	NOT USED	
R146	NOT USED	
R147	NOT USED	
R147	NOT USED	
R148	6-391	390 Ω, 1/2-watt
R149	6-511	510 Ω, 1/2-watt
R150	NOT USED	
R151	6-104-12	100 kΩ
R152	6-122-12	1200 Ω
R153	6-122-12	1200 Ω
R154	6-122-12	1200 Ω
R155	6-122-12	1200 Ω
R156	6-122-12	1200 Ω
R157	6-122-12	1200 Ω
R158	6-122-12	1200 Ω
R159	6-122-12	1200 Ω
R160	NOT USED	
R161	6-122-12	1200 Ω
R162	6-122-12	1200 Ω
R163	6-471	470 Ω, 1/2-watt
R164	6-122-12	1200 Ω
R165	6-103-12	10 kΩ
R166	6-183-12	18 kΩ
R167	6-122-12	1200 Ω
R168	6-122-12	1200 Ω
R169	3-2-2	.33 Ω, 2-watt
R170	6-681-12	680 Ω
R171	6-1001-12	1000 Ω, 1%
R172	6-6001-12	6000 Ω, 1%
R173	6-222-12	2200 Ω
R174	6-122-12	1200 Ω

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION

Resistors (Cont'd.)

R175	6-272-12	2700 Ω
R176	6-471	470 Ω, 1/2-watt
R177	6-122-12	1200 Ω
R178	6-392-12	3900 Ω
R179	6-392-12	3900 Ω
R180	6-122-12	1200 Ω
R181	6-471	470 Ω, 1/2-watt
R182	6-105-12	1 MΩ
R183	6-105-12	1 MΩ
R184	6-562-12	5600 Ω
R185	6-122-12	1200 Ω
R186	6-472-12	4700 Ω
R187	6-122-12	1200 Ω
R188	6-562-12	5600 Ω
R189	3-26-5	390 Ω, 5-watt
R190	6-101-12	100 Ω
R191	6-1002-12	10 kΩ, 1%
R192	6-2109-12	21 Ω, 1%
R193	6-4709-12	47 Ω, 1%
R194	6-3300-12	330 Ω, 1%
R195	11-90	200 Ω control
R196	6-562-12	5600 Ω
R197	6-101-12	100 Ω
R198	6-122-12	1200 Ω
R199	6-122-12	1200 Ω
R201	6-122-12	1200 Ω
R202	6-122-12	1200 Ω
R203	6-121-12	120 Ω
R204	6-122-12	1200 Ω
R205	6-121-12	120 Ω
R206	6-122-12	1200 Ω
R207	6-473-12	47 kΩ
R208	6-471	470 Ω, 1/2-watt
R209	6-471	470 Ω, 1/2-watt
R210	NOT USED	
R211	6-471	470 Ω, 1/2-watt
R212	6-471	470 Ω, 1/2-watt
R213	6-122-12	1200 Ω
R214	3-26-5	390 Ω, 5-watt
R215	6-122-12	1200 Ω
R216	3-41-10	33 Ω, 10-watt
R217	3-41-10	33 Ω, 10-watt

CAPACITORS

C1	21-70	.01 μF ceramic
C2	25-272	6000 μF electrolytic
C3	25-854	5600 μF electrolytic
C4	25-208	1500 μF electrolytic
C5	25-836	17 μF electrolytic
C101	21-722	330 pF ceramic
C102	21-722	330 pF ceramic
C103	21-722	330 pF ceramic

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION

Capacitors (Cont'd.)

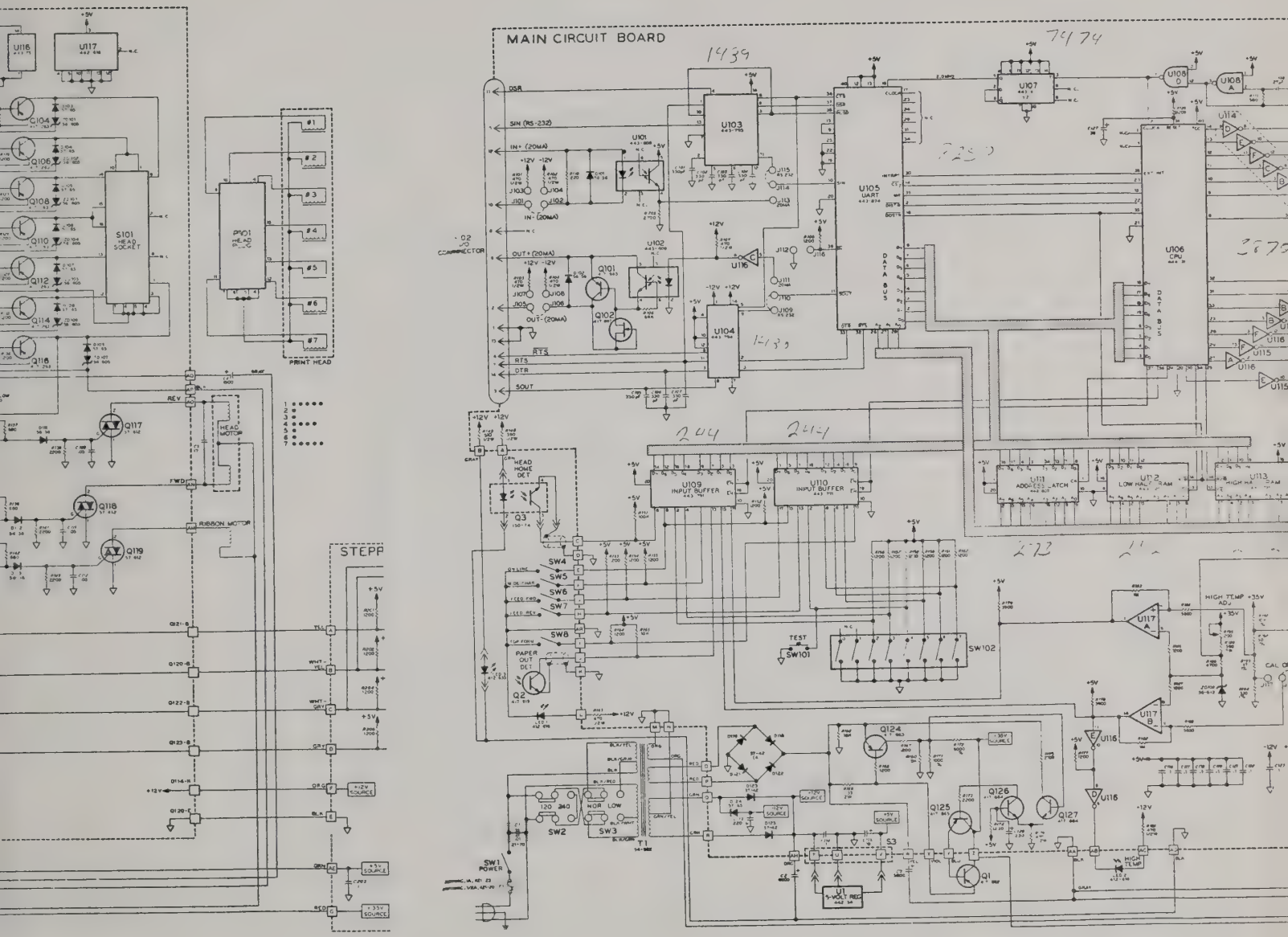
C104	21-722	330 pF ceramic
C105	21-722	330 pF ceramic
C106	21-722	330 μF ceramic
C107	21-722	330 pF ceramic
C108	21-6	27 pF ceramic
C109	21-143	.05 μF ceramic
C110	21-36	.002 μF ceramic
C111	21-143	.05 μF ceramic
C112	21-143	.05 μF ceramic
C113	25-901	220 μF electrolytic
C114	21-199	.1 μF ceramic
C115	25-220	10 μF electrolytic
C116	21-199	.1 μF ceramic
C117	21-199	.1 μF ceramic
C118	21-199	.1 μF ceramic
C120	NOT USED	
C121	21-199	.1 μF ceramic
C122	21-199	.1 μF ceramic
C123	21-199	.1 μF ceramic
C124	21-199	.1 μF ceramic
C125	25-824	500 μF electrolytic
C126	25-262	250 μF electrolytic
C127	25-281	39 μF tantalum
C201	21-46	.005 μF ceramic
C202	21-46	.005 μF ceramic
C203	21-199	.1 μF ceramic
C204	27-62	.68 μF Mylar

DIODES — TRANSISTORS — INTEGRATED CIRCUITS

See "Semiconductor Identification Charts."

GENERAL

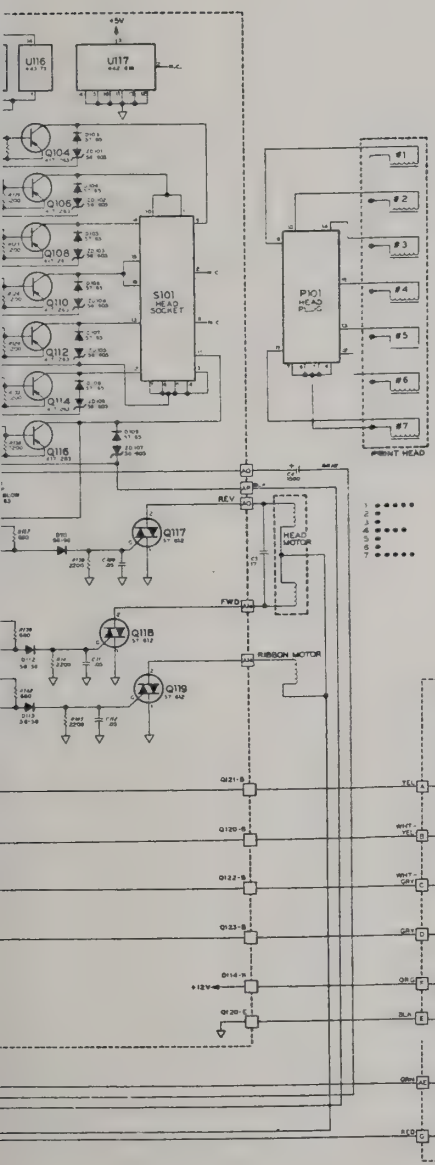
T1	54-962	Power transformer
SW1, SW4-SW8	64-860	6-section switch
SW2	60-54	120/240 switch
SW3	60-608	NOR/LOW switch
	266-996	Print head
	266-1007	Ribbon
	253-710	Cork ribbon tension washer
	253-167	Teflon clutch washer
	258-728	Clutch spring
	420-94	Head motor
	420-603	Paper drive motor
	420-602	Ribbon motor
F1	421-20	1/2-ampere, slow-blow fuse
F1	421-23	1-ampere, slow-blow fuse
F101	421-63	6/10-ampere, slow-blow fuse
	349-1	Head drive cable (3.5 feet)


MAIN CIRCUIT BOARD
PRINT HEAD
HEAD MOTOR
RIBBON MOTOR
PAPER OUT DET
HEAD HOME DET
SW1 POWER
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW101
SW102
TEST
DSR
SIN (RS-232)
IN+ (20MA)
IN- (20MA)
OUT+ (20MA)
OUT- (20MA)
RTS
DTR
SOUT
U101
U102
U103
U104
U105 UART
U106 CPU
U107
U108
U109 INPUT BUFFER
U110 INPUT BUFFER
U111 ADDRESS LATCH
U112 LOW HALF RAM
U113 HIGH HALF RAM
U114
U115
U116
U117
DATA BUS
ADDRESS BUS
HIGH TEMP ADJ
+5V SOURCE
+12V SOURCE
-12V SOURCE
+35V SOURCE
HIGH TEMP
5-VOLT REG
T1
S101 HEAD SOCKET
P101 HEAD
Q1
Q2
Q3
Q101
Q102
Q104
Q106
Q108
Q110
Q112
Q114
Q116
Q117
Q118
Q119
Q120
Q121
Q122
Q123
Q124
Q125
Q126
Q127
J101
J102
J103
J104
J105
J106
J107
J108
J109
J110
J111
J112
J116
.02 I/O CONNECTOR

SCHEMATIC OF THE HEATH LINE PRINTER

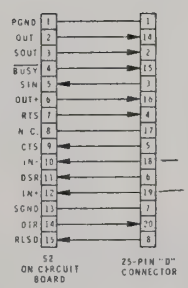
Model H14

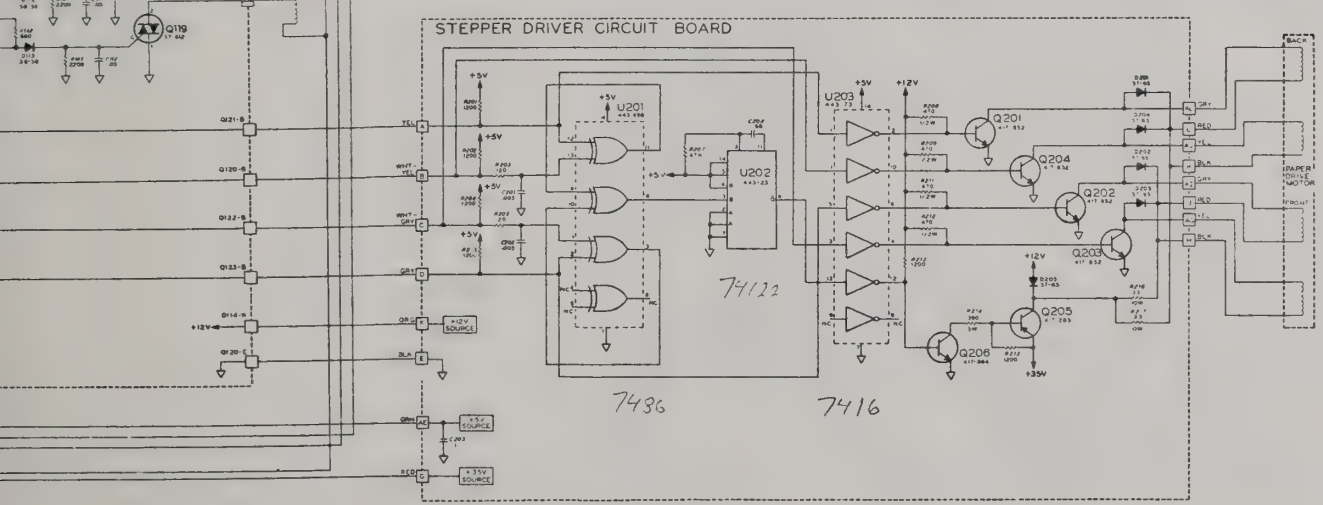
Part of 595-2173-06

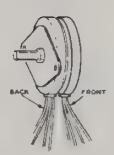


NOTES.

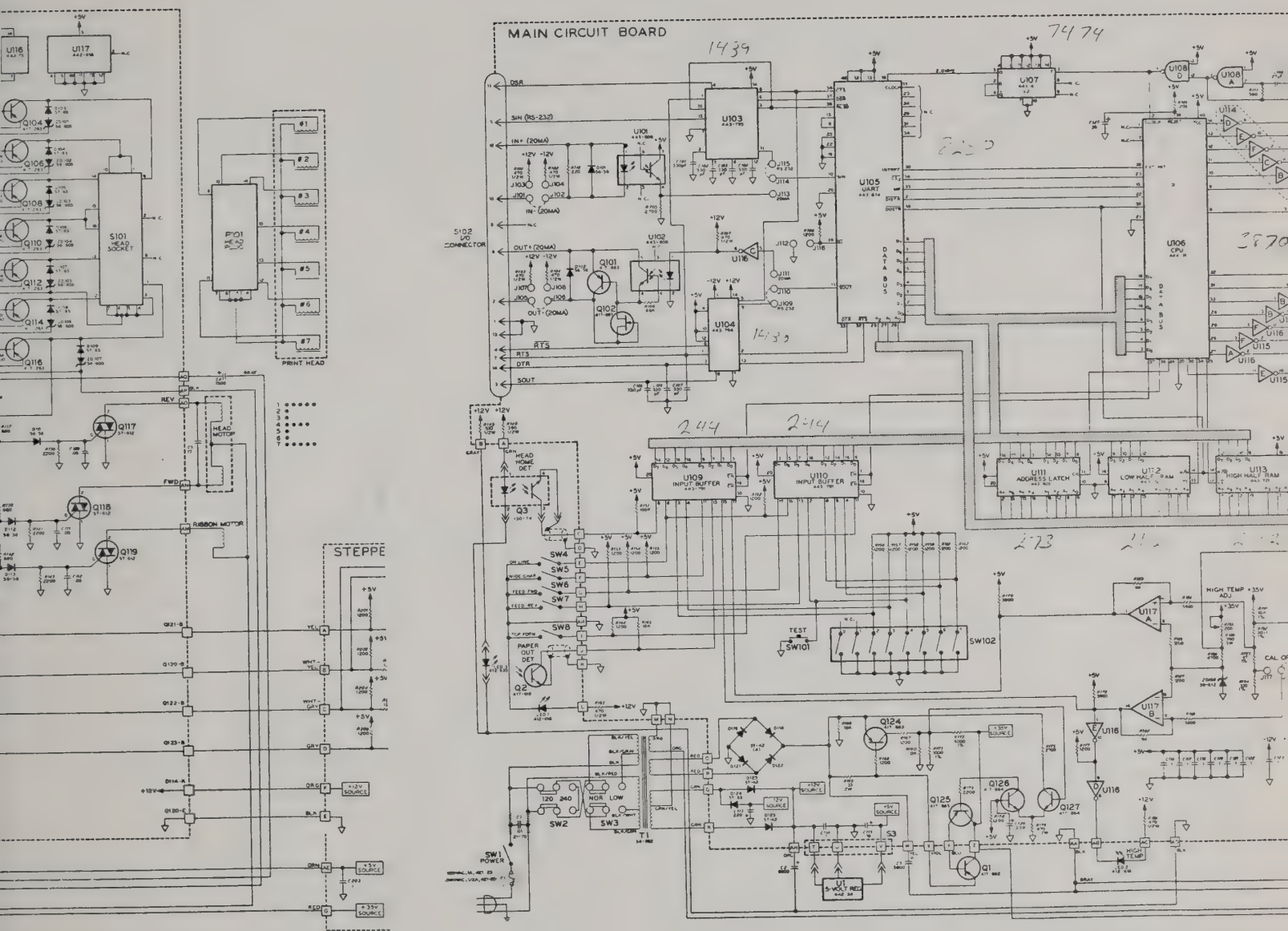
1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS.
 1-99 PARTS MOUNTED ON THE CHASSIS AND MAIN CIRCUIT BOARD.
 100-199 PARTS MOUNTED ON THE CIRCUIT BOARD.
2. ALL RESISTORS ARE 1/4 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1,000; M=1,000,000).
3. ALL CAPACITORS ARE IN µF UNLESS MARKED OTHERWISE.
4. ▽ THIS SYMBOL INDICATES CIRCUIT BOARD GROUND
5. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.
6. □ THIS SYMBOL INDICATES WHERE A WIRE IS SOLDERED TO A CIRCUIT BOARD.
7. ≫ THIS SYMBOL INDICATES A CONNECTOR.
8. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%.
9. PARTS IN SHADED AREAS ARE CRITICAL FOR CONTINUED SAFETY. REPLACE THEM ONLY WITH PARTS OF THE SAME RATING OR WITH THE PROPER HEATH PARTS.

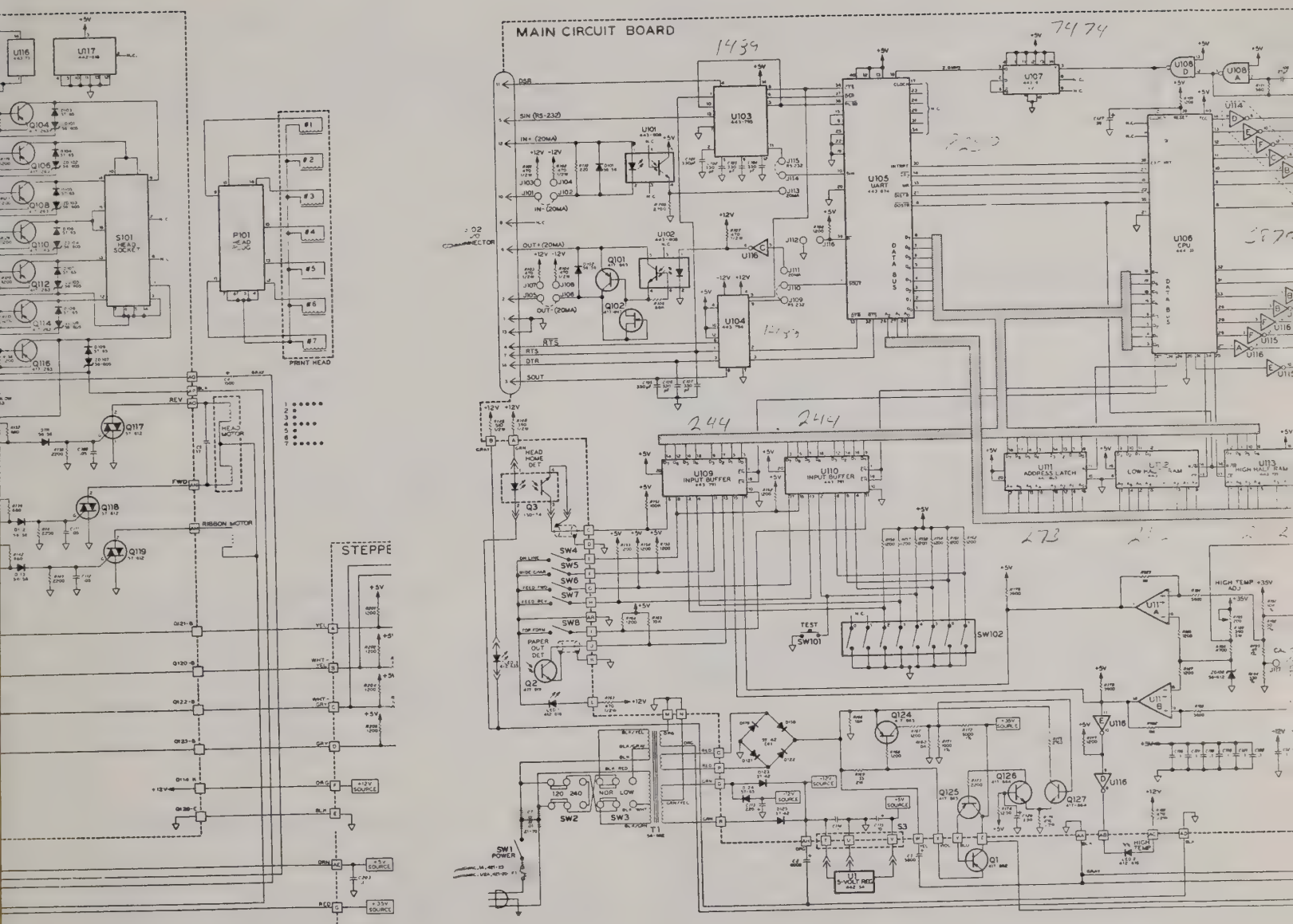






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MAIN CIRCUIT BOARD
PRINT HEAD
STEPPE
RIBBON MOTOR
HEAD MOTOR
HEAD HOME DET
PAPER OUT DET
5102 I/O CONNECTOR
S101 HEAD SOCKET
P101 HEAD PLUG
U101
U102
U103
U104
U105 UART
U106 CPU
U107
U108
U109 INPUT BUFFER
U110 INPUT BUFFER
U111 ADDRESS LATCH
U112 LOW HALF RAM
U113 HIGH HALF RAM
U114
U115
U116
U117
Q101
Q102
Q104
Q106
Q108
Q110
Q112
Q114
Q116
Q117
Q118
Q119
Q120
Q121
Q122
Q123
Q124
Q125
Q126
Q127
Q1
Q2
Q3
SW1 POWER
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW101 TEST
SW102
S3
T1
U1 5-VOLT REG
DSR
SIN (RS-232)
IN+ (20MA)
IN- (20MA)
OUT+ (20MA)
OUT- (20MA)
RTS
DTR
SOUT
DATA BUS
HIGH TEMP ADJ
HIGH TEMP
REV
FWD
+5V
+12V
-12V
+35V
+5V SOURCE
+12V SOURCE
+35V SOURCE
120 240
NOR LOW


MAIN CIRCUIT BOARD
U103
U105 UART
U106 CPU
U107
U108
U109 INPUT BUFFER
U110 INPUT BUFFER
U111 ADDRESS LATCH
U112 LOW RAM
U113 HIGH RAM
U101
U102
U104
S101 HEAD SOCKET
P101 HEAD
PRINT HEAD
HEAD MOTOR
RIBBON MOTOR
STEPPE
HEAD HOME DET
PAPER OUT DET
SW1 POWER
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW101
SW102
TEST
HIGH TEMP ADJ
HIGH TEMP
5-VOLT REG
DSR
SIN (RS-232)
RTS
DTR
SOUT
REV
FWD
+5V SOURCE
+12V SOURCE
-12V SOURCE
+35V SOURCE

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.

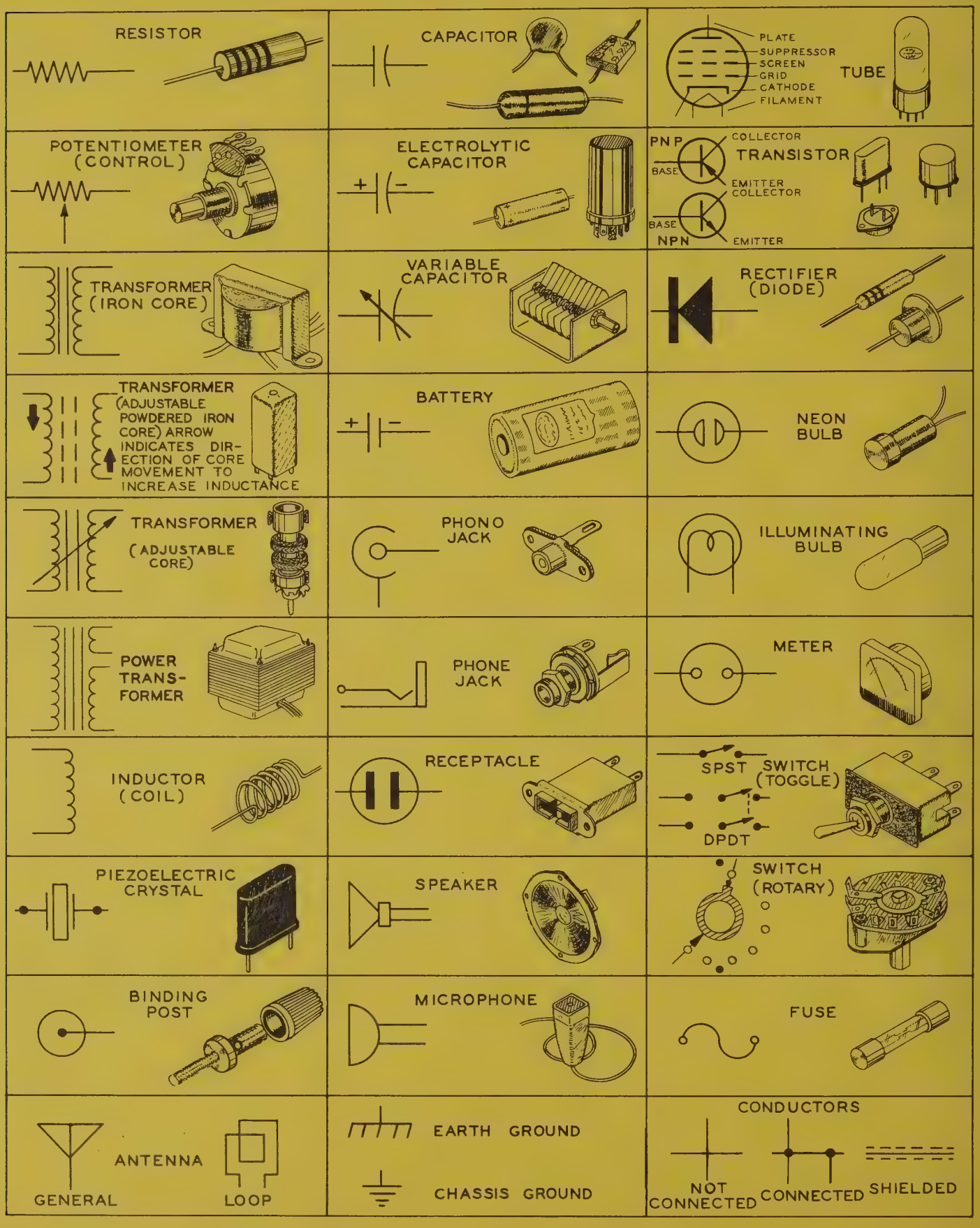
PRICE $1.00

HEATHKIT®
ASSEMBLY MANUAL

SSB AMPLIFIER
MODEL HA-14

TYPICAL COMPONENT TYPES

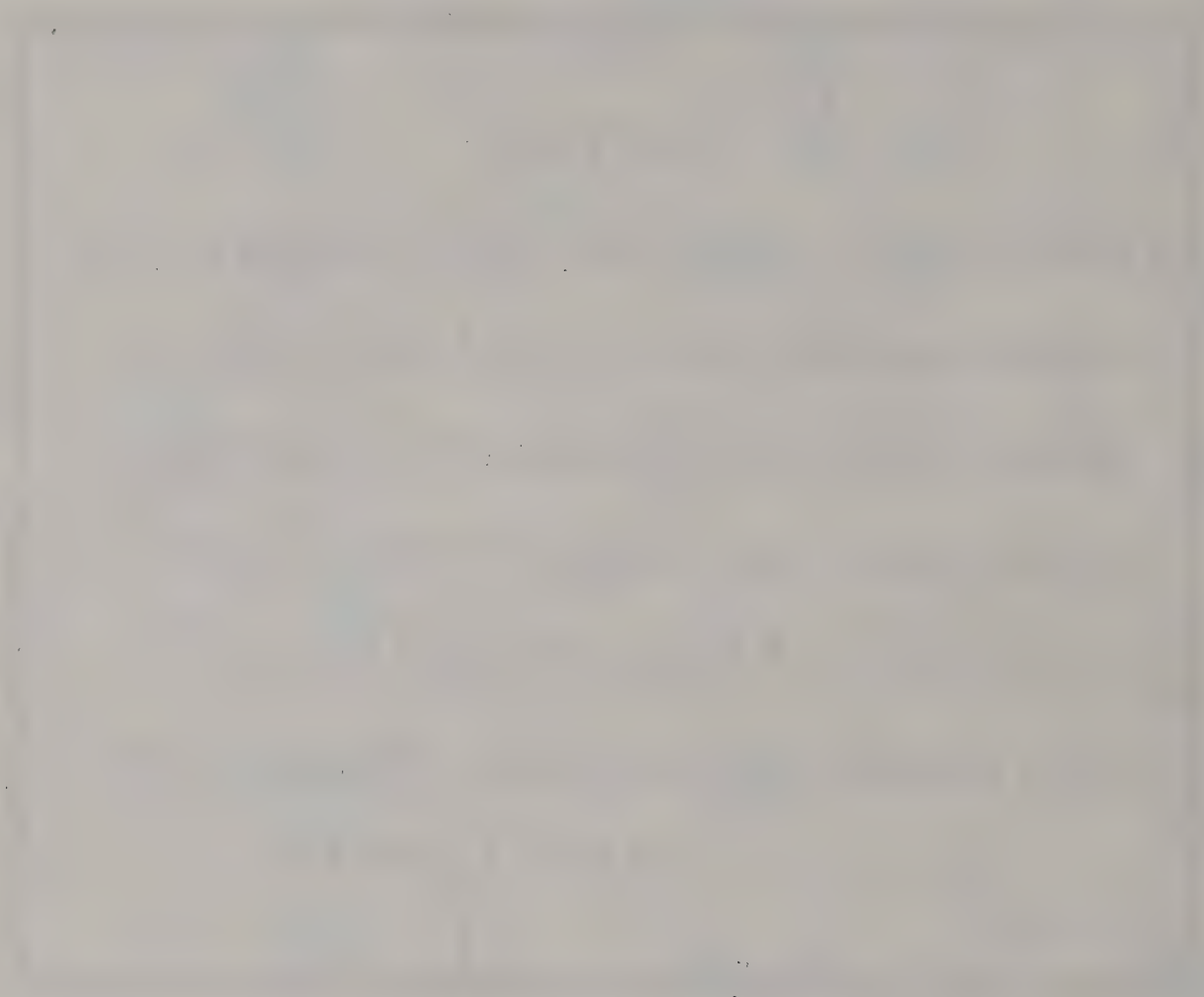
This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



CAUTION

Use extreme care during initial testing and all subsequent operation of this Linear Amplifier. While the HA-14 is designed for maximum safety, never lose respect for the high voltage present in this unit. Protect yourself always against lethal or severe electric shock.

HEATH COMPANY



Assembly
and
Operation
of the

HEATHKIT®

SSB LINEAR AMPLIFIER

MODEL HA-14



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BENTON HARBOR,
MICHIGAN

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7/29/66

INTRODUCTION

In keeping with the current trend toward higher power SSB (single-sideband) service, the Heathkit Model HA-14 SSB Linear Amplifier is designed to provide high output power for Mobile and fixed station use. Nearly all of the modern SSB Exciters now available can be used as a driver for this Linear Amplifier.

This SSB Linear Amplifier is small and compact for easy mounting in most automobiles. The companion Heathkit Model HP-14 DC Power Supply used with the Linear Amplifier makes an excellent combination for mobile use. If desired, the Linear Amplifier can be used with the Heathkit Model HP-24 AC Power Supply to make an ideal desk-top 1000 watt PEP amplifier.

The wrap-around construction provides a rugged chassis for good stability, and permits increased cooling of the final tubes. The all-steel cabinet is perforated on all sides for good air circulation to prolong tube and component life.

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be highly stable and dependable performance. We suggest that you retain the manual in your files for future reference, both in the use of the equipment and for its maintenance.

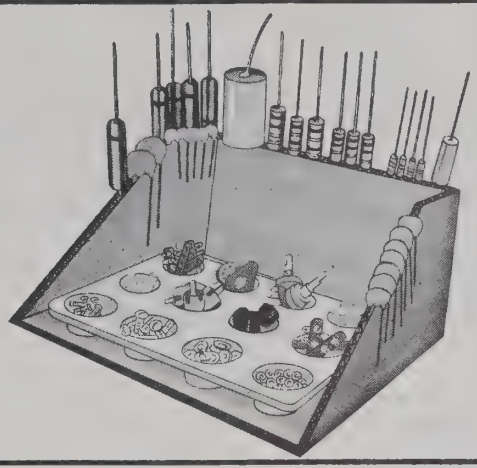
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacements section and supply the information called for therein.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a penknife or a tool for stripping insulation from wires; and a soldering iron (or gun). A set of nut drivers, while not necessary, will aid extensively in construction of the kit.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



PARTS LIST

The numbers in parentheses in the Parts List are keyed to the numbers on the Parts Pictorial (fold-out from Page 5) to aid in parts identification.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1)1-4	2	330 Ω (orange-orange-brown)
1-16	2	4700 Ω (yellow-violet-red)
1 Watt		
(2)1A-14	3	33 Ω (orange-orange-black)
1A-9	1	10 KΩ (brown-black-orange)
1A-3	1	3300 Ω (orange-orange-red)
CAPACITORS		
(3)20-40	1	470 μμf molded
20-123	1	500 μμf molded, 2 KV
20-42	1	510 μμf molded
(4)20-124	2	115 μμf resin
20-108	3	200 μμf resin
20-111	1	230 μμf resin
20-121	1	290 μμf resin
20-112	1	310 μμf resin
20-131	1	360 μμf resin
(5)21-78	1	5 μμf disc
21-60	1	18 μμf disc
21-14	2	.001 μfd disc
21-90	2	.001 μfd 3 KV disc
21-31	9	.02 μfd disc
(6)21-109	1	100 μμf tubular
21-112	1	350 μμf tubular

PART No.	PARTS Per Kit	DESCRIPTION
Capacitors (cont'd.)		
21-80	1	1000 μμf tubular
(7)25-39	1	2 μfd electrolytic
(8)26-96	1	150 μμf variable
CONTROL-SWITCHES-RELAY		
(9)61-3	1	DPST toggle switch
(10)63-374	1	5-position, 3-wafer rotary switch
63-381	1	Switch-control, 20 KΩ control
69-5	1	110 V AC DPDT relay
COILS-CHOKES-TRANSFORMERS		
(11)40-591	1	80 meter input coil
40-592	1	40 meter input coil
40-593	1	20 meter input coil
40-594	1	15 meter input coil
40-595	1	10 meter input coil
(12)40-597	1	80, 40, and 20 meter final tank coil
(13)40-645	1	10 and 15 meter final tank coil
(14)45-18	1	28 μh RF choke
(15)45-36	1	7 μh RF choke
(16)45-53	2	Parasitic plate choke
(17)45-60	1	10 μh RF choke
(18)45-61	1	50 μh RF choke
45-4	1	1.1 mh RF choke

PART No.	PARTS Per Kit	DESCRIPTION
DIODES-TUBES		
(19) 56-24	1	IN458 silicon diode (yellow-green-gray)
(20) 56-26	2	IN191 crystal diode (brown-white-brown)
411-198	2	572-B/T-160-L tube
412-17	1	Pilot lamp
407-108	1	Meter
HARDWARE		
(21) 250-174	2	8-32 x 1/4" screw
(22) 250-13	2	6-32 x 1" screw
(23) 250-26	4	6-32 x 5/8" screw
(24) 250-89	13	6-32 x 3/8" screw
(25) 250-218	4	6-32 x 3/8" phillips head screw
(26) 250-56	24	6-32 x 1/4" screw
(27) 250-138	5	6-32 x 3/16" screw
(28) 250-4	4	4-40 x 3/8" screw
(29) 250-43	3	8-32 x 1/4" setscrew
(30) 250-8	4	#6 sheet metal screw
(31) 250-143	1	6-32 x 1/2" stud
(32) 252-7	3	Control nut
(33) 252-4	2	8-32 nut
(34) 252-3	38	6-32 nut
(35) 252-15	4	4-40 nut
(36) 253-60	8	#6 flat washer
(37) 253-3	1	#10 flat fiber washer
(38) 254-4	2	Control lockwasher
(39) 254-2	2	#8 lockwasher
(40) 254-1	42	#6 lockwasher
(41) 254-9	6	#4 lockwasher
(42) 259-10	1	Control solder lug
(43) 259-1	16	#6 solder lug
(44) 255-21	1	5/16" x 7/8" spacer
(45) 255-23	2	5/16" x 15/32" spacer
INSULATOR-TERMINAL STRIPS-SOCKETS		
(46) 71-4	1	Ceramic insulator
(47) 431-45	1	6-lug terminal strip
(48) 431-40	2	4-lug terminal strip
(49) 431-14	1	2-lug terminal strip
(50) 431-50	1	1-lug terminal strip
(51) 431-51	1	2-lug vertical terminal strip
(52) 432-45	1	Male power plug
(53) 432-46	2	Female power socket
(54) 432-52	1	High voltage connector

PART No.	PARTS Per Kit	DESCRIPTION
Insulator-Terminal Strips-Sockets (cont'd.)		
432-55	1	Male high voltage connector
(55) 434-9	2	4-pin tube socket
(56) 434-42	1	Phono socket
434-88	1	Pilot lamp socket
(57) 436-5	1	Coaxial socket
WIRE-CABLE-SLEEVING		
340-1	1	Bare wire
348-1	1	Enameled wire
344-21	1	Red stranded hookup wire
344-29	1	Blue stranded hookup wire
344-50	1	Black hookup wire
344-54	1	Yellow hookup wire
344-55	1	Green hookup wire
344-56	1	Blue hookup wire
343-2	1	RG-58 coaxial cable (large)
343-7	1	RG-174 coaxial cable (small)
346-1	1	Sleeving
346-10	1	3/8" fiberglas sleeving
SHEET METAL PARTS		
90-296	1	Cabinet
(58) 200-M432	1	Subchassis
201-M33P141	1	Chassis frame
203-M408P140	1	Front panel
(59) 204-M647	1	Support bracket
(60) 206-M275	1	Input shield
MISCELLANEOUS		
435-1	2	Socket mounting ring
(61) 207-42	2	Tube clamp
(62) 260-34	2	Anode clip
260-32	2	Lock clip
261-9	4	Rubber foot
261-21	2	Rubber foot
(63) 438-4	2	Phono plug
(64) 438-9	1	Coaxial plug
(65) 438-12	1	Coaxial plug insert
(66) 455-10	1	3/8" bushing
(67) 455-11	1	Split bushing
(68) 453-135	1	Extension shaft
(69) 456-16	1	Shaft coupling
462-191	3	Knob
(70) 462-195	1	Lever knob
490-5	1	Nut starter
490-23	1	Allen wrench
331-6		Solder
595-732	1	Manual

PROPER SOLDERING TECHNIQUES

Only a small percentage of customers find it necessary to return equipment for factory service. By far the largest portion of malfunctions in this equipment are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 25 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly. Keep the iron tip clean by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

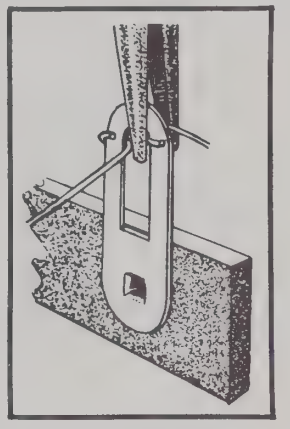
1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire). In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the assembly step.

2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.

3. Leads on resistors, capacitors, and similar components are generally much longer than need be to make the required connections. In these cases, the leads should be cut to proper length before the part is installed. In general, the leads should be just long enough to reach their terminating points.

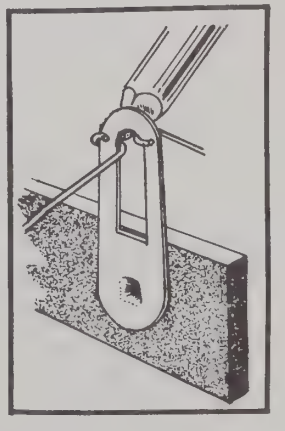
4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated assembly step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.

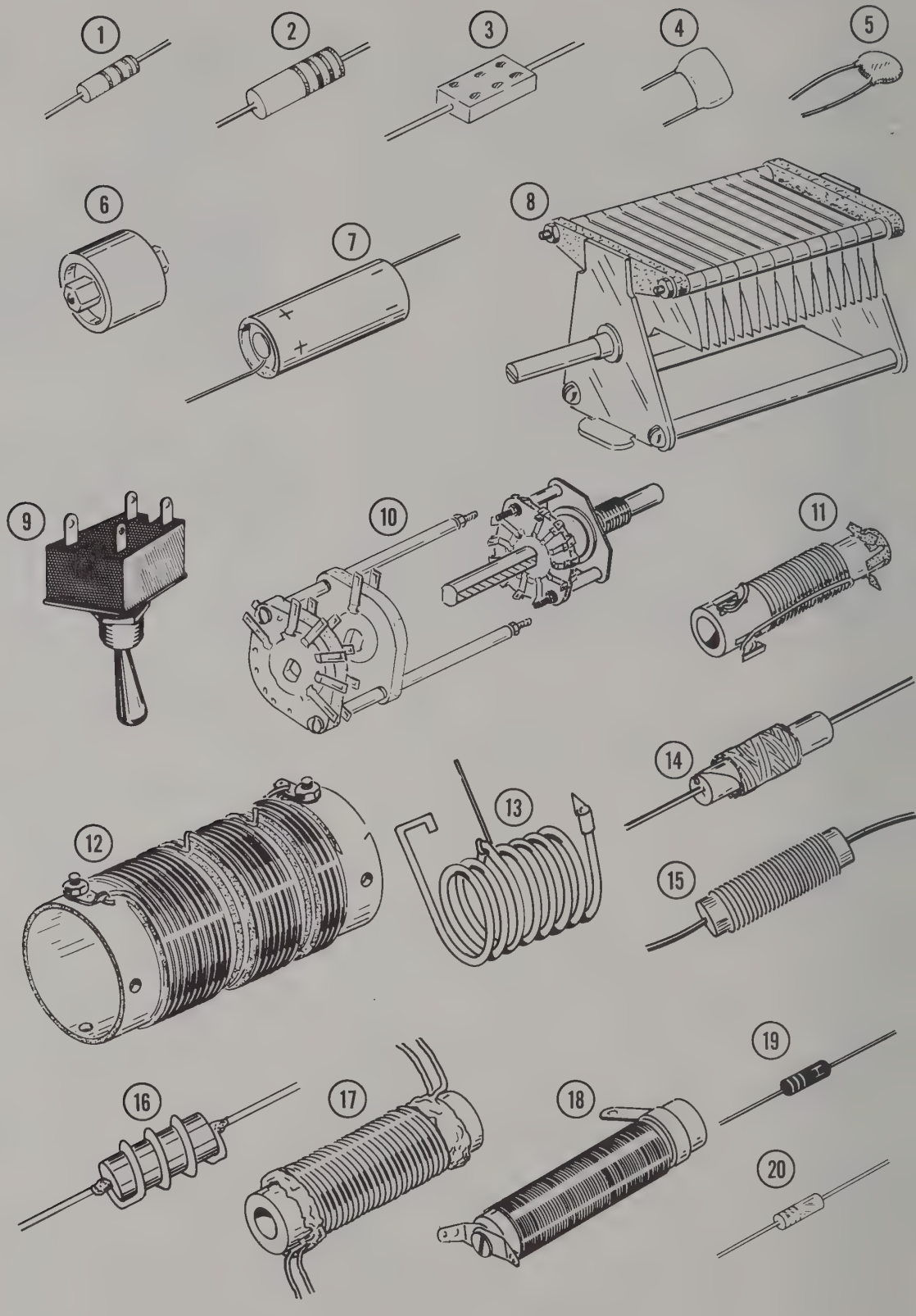
5. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the lead is too large to allow bending or if the step states that it is not to be crimped, position it so that a good solder connection can still be made.



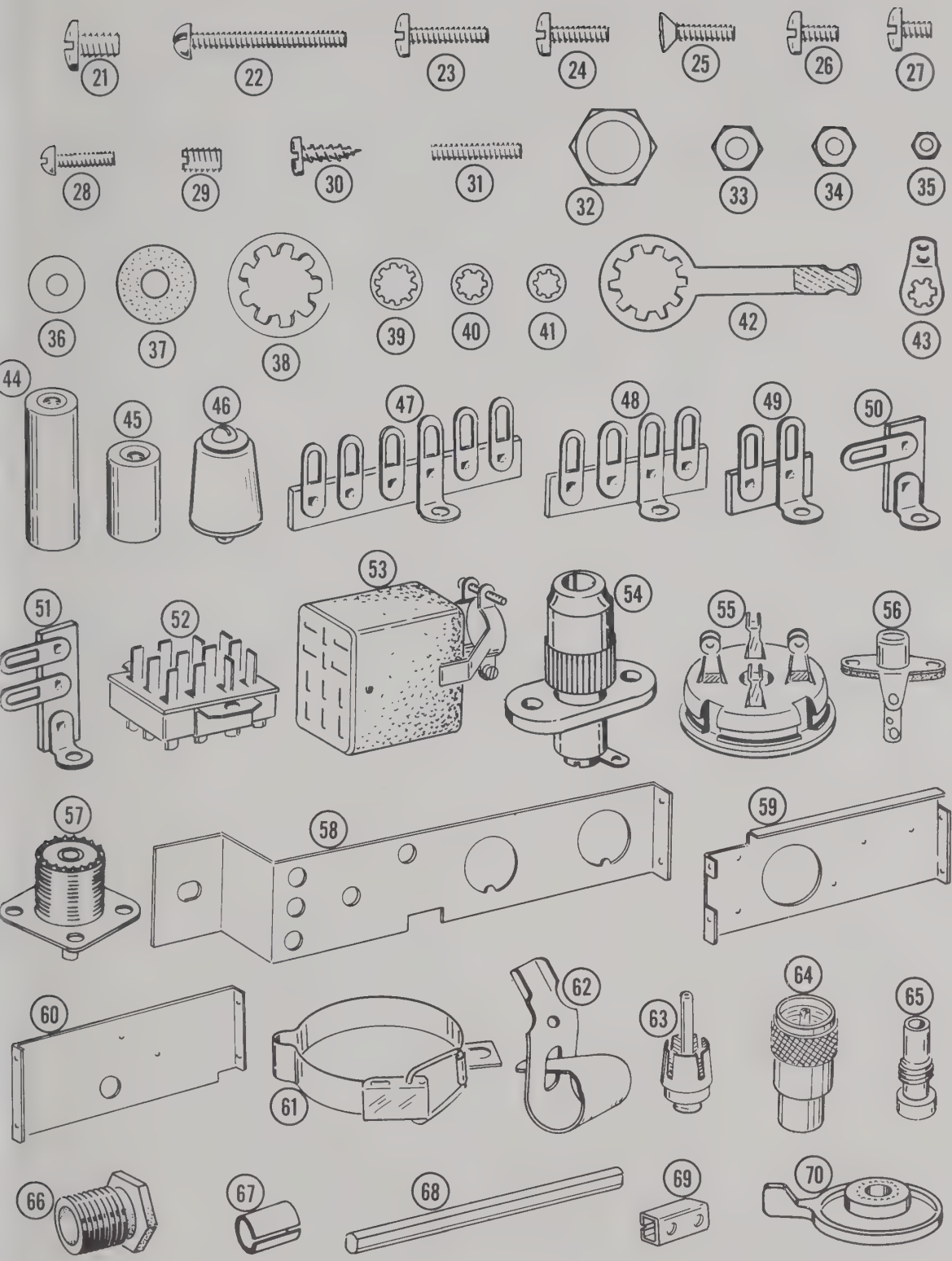
6. Position the work, if possible, so that gravity will help to keep the solder where you want it.

7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.




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STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each wire and part in colored pencil on the Pictorial as it is added.

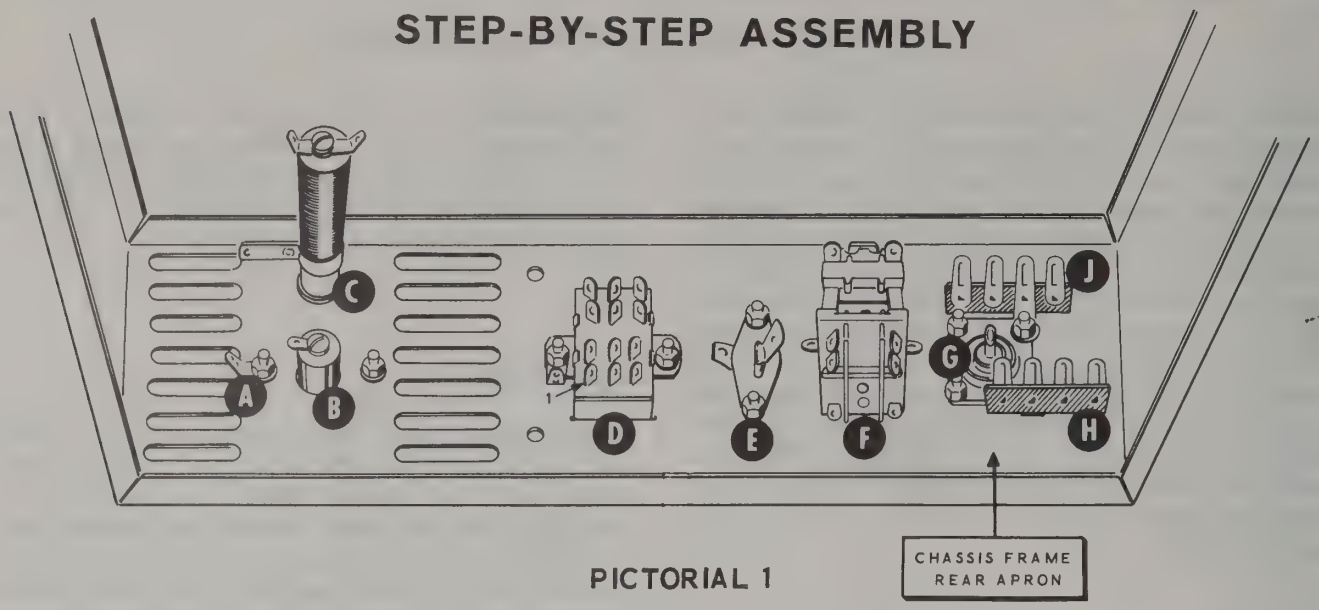
ILLUSTRATIONS

The fold-out diagrams in this manual may be removed and attached to the wall above your working area; but because they are an integral part of the instructions, they should be returned to the manual after the kit is completed. In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

SOLDERING

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a wire to lug 1 (S-2)," it will be understood that there will be two wires connected to the terminal at the time it is soldered. (In cases where a wire passes through a terminal or lug and then connects to another point, it will count as two wires, one entering and one leaving the terminal.)

STEP-BY-STEP ASSEMBLY



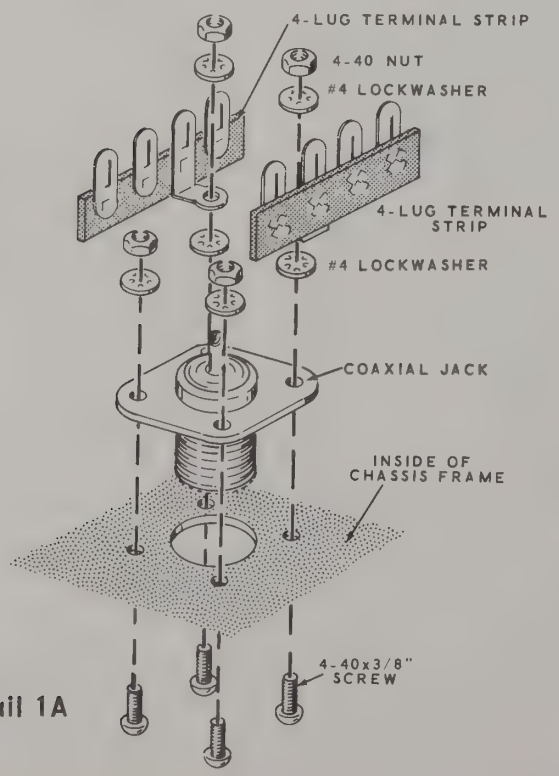
PICTORIAL 1

CHASSIS FRAME PARTS MOUNTING

Refer to Pictorial 1 for the following steps.

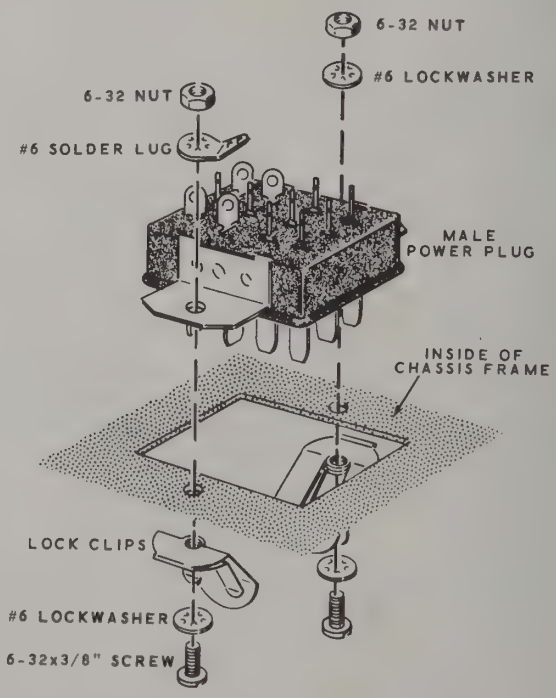
() Position the chassis frame as shown in Pictorial 1.

() Referring to Detail 1A, mount the coaxial socket at G with 4-lug terminal strips at H and J. Use 4-40 x 3/8" screws, #4 lockwashers, and 4-40 nuts. Position the terminal strips as shown.

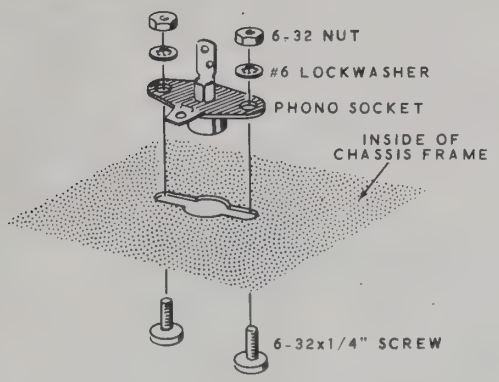


Detail 1A

() Refer to Detail 1B and mount the male power plug and two lock clips at D with a #6 solder lug on one mounting screw. Use 6-32 x 3/8" screws, #6 lockwashers, a #6 solder lug, and 6-32 nuts. Position lug 1 of the power plug and the #6 solder lug as shown in Pictorial 1.



Detail 1B

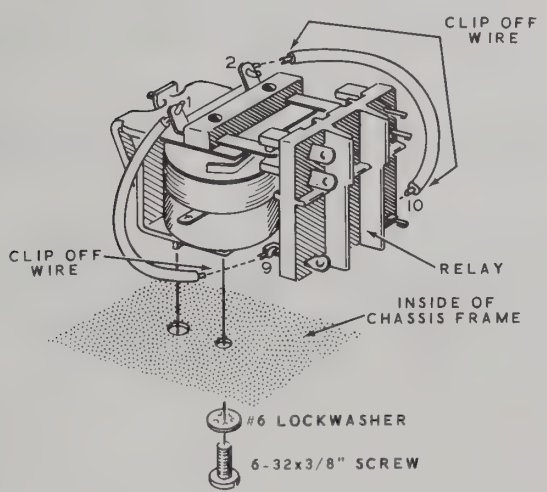


Detail 1C

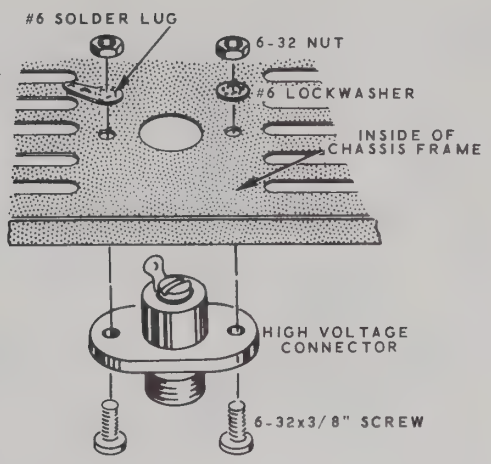
() Refer to Detail 1C and mount the phono socket at E with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts. Position the ground lug of the socket as shown.

() Clip the wire extending from lugs 2, 9, and 10 of relay F as shown in Detail 1D. Do not clip the wire from lug 1; it will be connected later.

() Referring to Detail 1D, mount the relay at F with a 6-32 x 3/8" screw and a #6 lockwasher. Position the relay so that the locating tab on the bottom of the relay fits into the locating slot in the chassis frame.



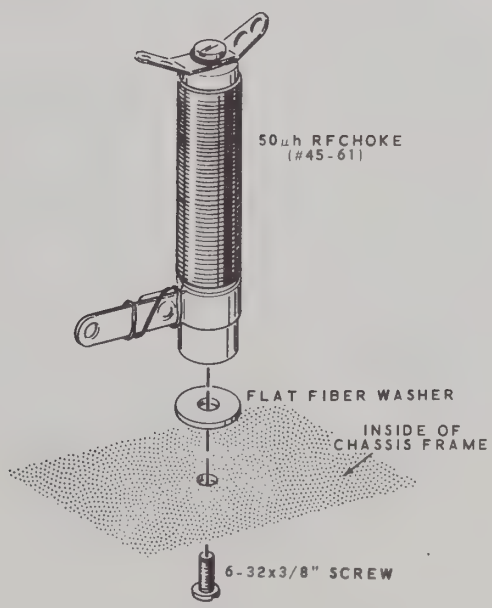
Detail 1D



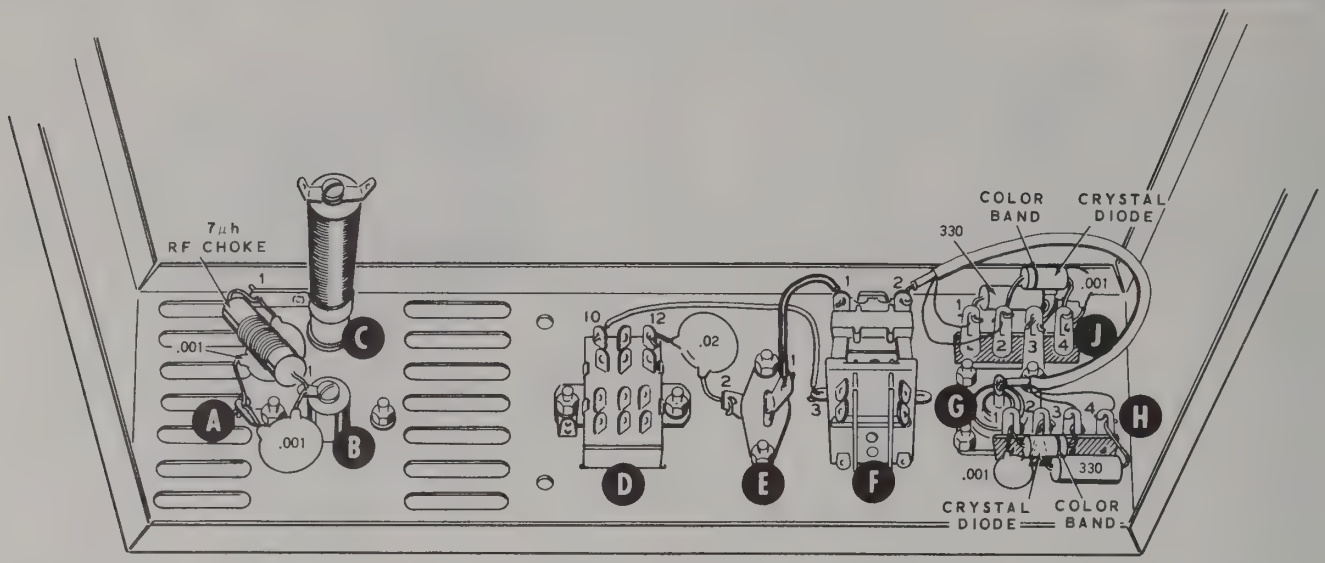
Detail 1E

() Mount the high voltage connector socket at B and a #6 solder lug at A. Use 6-32 x 3/8" screws, a #6 lockwasher, a #6 solder lug, and a 6-32 nut as shown in Detail 1E.

() Refer to Detail 1F and mount the 50 μh RF choke (#45-61) at C. Use a 6-32 x 3/8" screw and a flat fiber washer. Do not overtighten the screw or the ceramic form will crack. Position the choke lugs as shown in Pictorial 1.



Detail 1F



PICTORIAL 2

Refer to Pictorial 2 for the following steps.

() Connect a .001 μfd 3 KV disc capacitor from lug 1 of high voltage connector B (NS) to solder lug A (NS).

() Connect a .001 μfd 3 KV disc capacitor from lug 1 of RF choke C (NS) to solder lug A (S-2).

() Connect a 7 μh RF choke (#45-36) from lug 1 of high voltage connector B (S-2) to lug 1 of RF choke C (S-2).

() Connect a 3-1/2" yellow wire from lug 10 of power plug D (NS) to lug 3 of relay F (S-1).

() Connect a .02 μfd disc capacitor from lug 12 of power plug D (NS) to lug 2 of phono socket E (NS).

() Remove 1/4" of insulation from the free end of the wire extending from lug 1 of relay F. Connect the wire to lug 1 of phono socket E (S-1).

() Connect a .001 μfd disc capacitor between lugs 1 (NS) and 2 (NS) of terminal strip H.

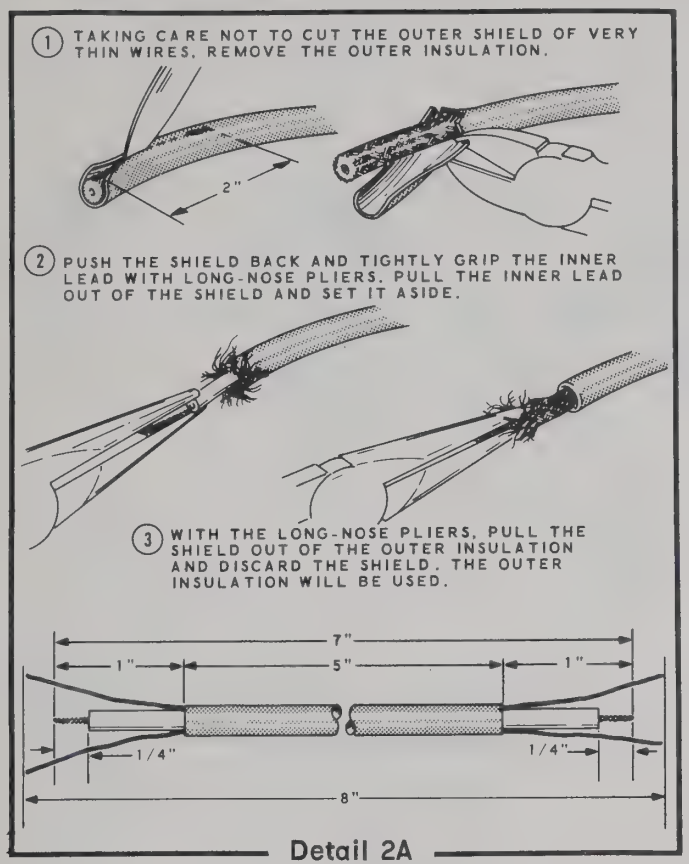
() Connect a 330 Ω (orange-orange-brown) resistor between lugs 2 (NS) and 4 (NS) of terminal strip H.

() Connect the lead at the color band end of a crystal diode (brown-white-brown) to lug 3 (NS) and the other lead to lug 1 (NS) of terminal strip H.

() Connect a .001 μfd disc capacitor between lugs 3 (NS) and 4 (NS) of terminal strip J.

() Connect a 330 Ω (orange-orange-brown) resistor between lugs 1 (NS) and 3 (NS) of terminal strip J.

() Connect the lead from the color band end of a crystal diode (brown-white-brown) to lug 2 (NS) and the other lead to lug 4 (NS) of terminal strip J.



Detail 2A

Refer to Detail 2A for the following steps.

() Cut a 7" length of the RG-58 coaxial cable (large) and remove the inner lead and shield braid. The shield braid may be discarded.

() Remove 1/4" of insulation from each end of the inner lead and melt a small amount of solder on the exposed wire ends to hold the strands together.

() Cut two 8" lengths of enameled copper wire. Scrape the enamel from each end of the two wires. Use a knife or some other sharp-edged tool. Melt a small amount of solder on the scraped wire ends to help with soldering later.

() Place one of the enameled wires through the outer insulation of the length of coaxial cable. Mark both ends of this wire so it can be identified later. A length of tape works very well for this.

() Place the remaining enameled wire through the insulation.

() Place the inner lead of the coaxial cable through the insulation with the enameled wires.

() Position the cable on the rear apron as shown in Pictorial 2. At one end of this cable, connect the inner lead and enameled copper wires as follows:

() The inner lead to lug 1 of coaxial socket G (S-1).

() The marked enameled wire to lug 4 of terminal strip H (S-2).

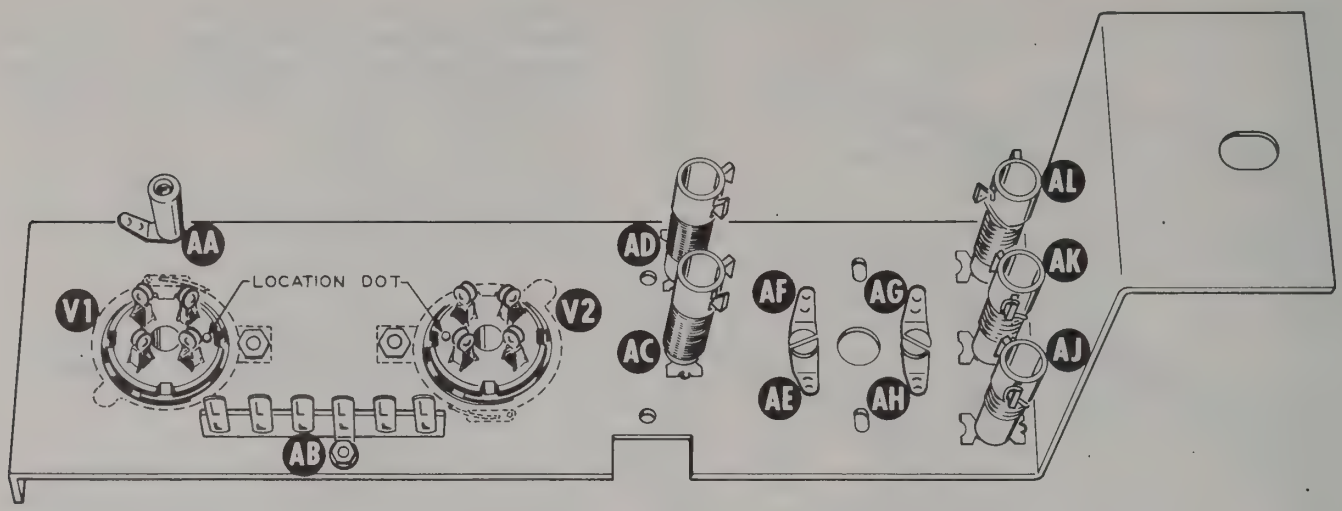
() The unmarked enameled wire to lug 3 of terminal strip H (S-2).

At the other end of this cable, connect the inner lead and enameled copper wires as follows:

() The inner lead to lug 2 of relay F (S-1).

() The marked enameled wire to lug 2 of terminal strip J (S-2).

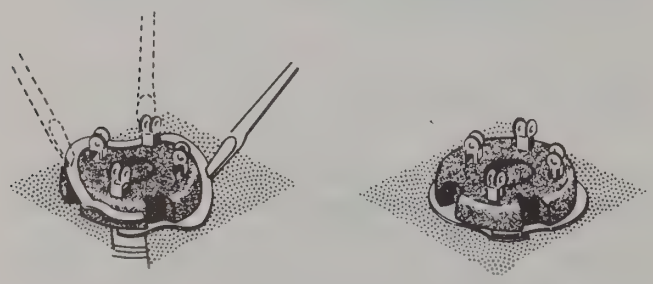
() The remaining enameled wire to lug 1 of terminal strip J (S-2).



PICTORIAL 3

Refer to Pictorial 3 for the following steps.

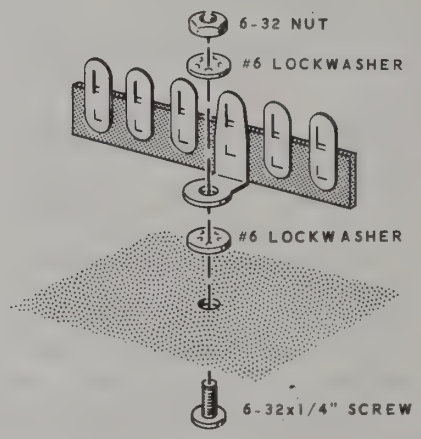
() Refer to Detail 3A and mount the 4-pin tube sockets at V1 and V2 with socket mounting rings. Position the location dot of the tube sockets as shown in Pictorial 3.



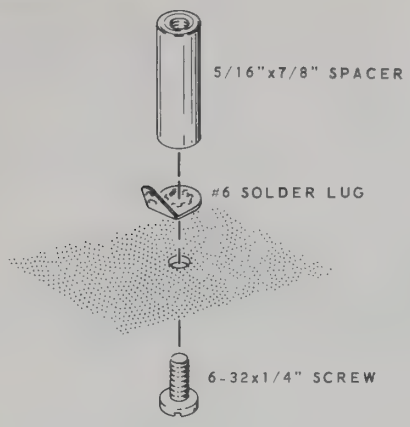
HOLD THE SOCKET IN THE CHASSIS AND PLACE ONE END OF THE RING INTO THE GROOVE OF THE SOCKET. USING A SCREWDRIVER, PRESS THE RING INTO THE GROOVE AROUND THE SOCKET.

Detail 3A

() Referring to Detail 3B, mount a 6-lug terminal strip at AB. Use a 6-32 x 1/4" screw, #6 lockwashers, and a 6-32 nut.



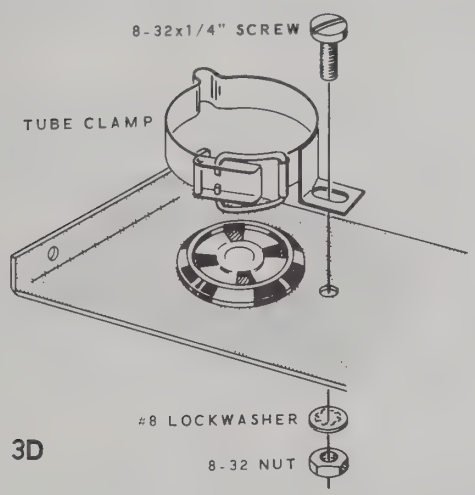
Detail 3B



Detail 3C

() Mount the 5/16" x 7/8" spacer at AA with a 6-32 x 1/4" screw and a #6 solder lug, as shown in Detail 3C. Position the solder lug as shown in Pictorial 3.

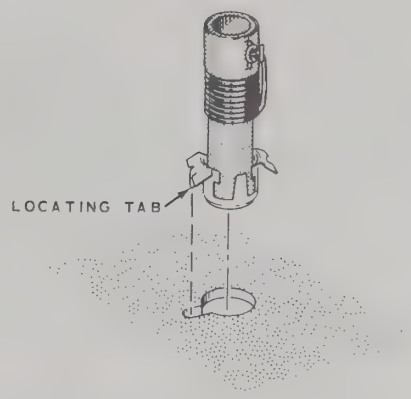
() Referring to Detail 3D, mount a tube clamp over sockets V1 and V2. Use 8-32 x 1/4" screws, #8 lockwashers, and 8-32 nuts. Position the tube clamps as shown by the dotted lines on Pictorial 3.



Detail 3D

() Mount #6 solder lugs at AE and AF with a 6-32 x 1/4" screw and 6-32 nut. Position the solder lugs as shown.

() Mount #6 solder lugs at AG and AH with a 6-32 x 1/4" screw and 6-32 nut. Position the solder lugs as shown.

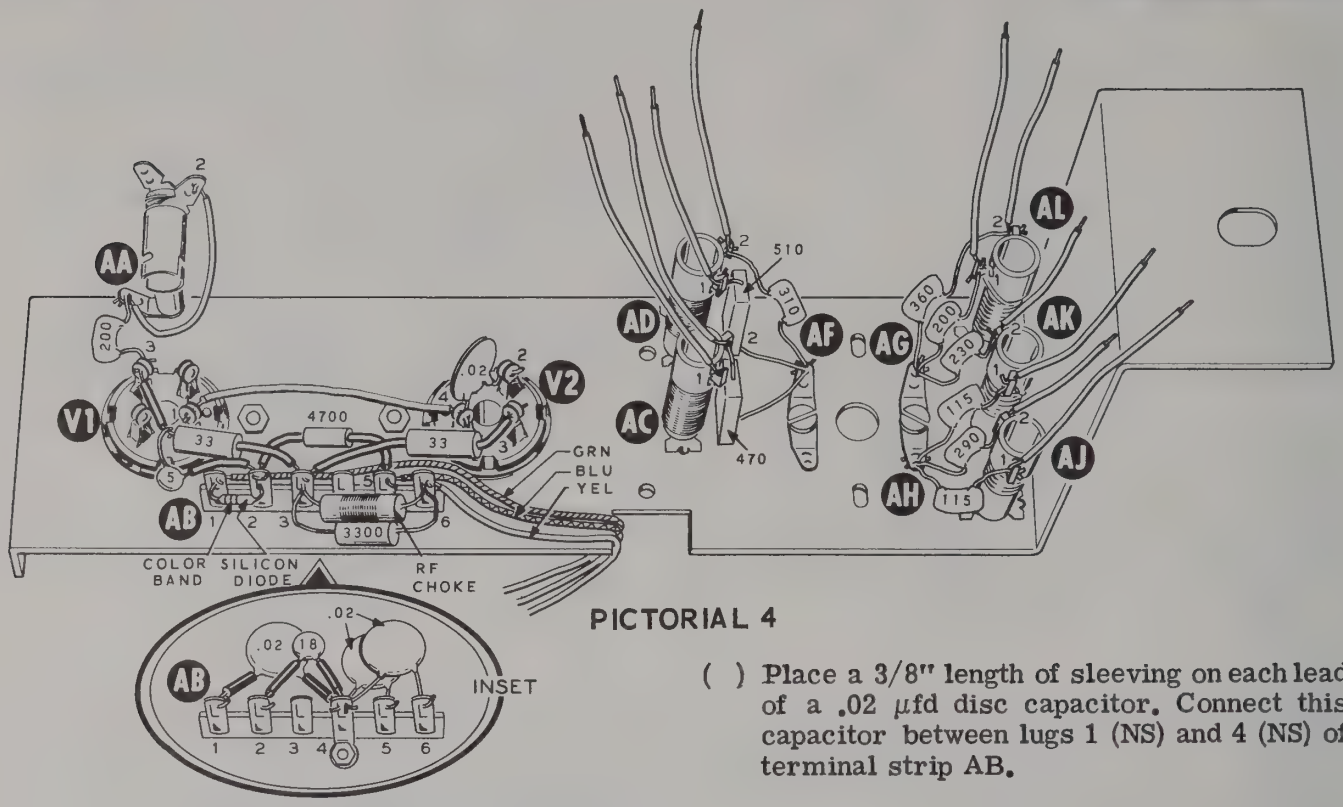


Detail 3E

() Refer to Detail 3E and mount the 80-meter input coil (#40-591) at AC.

() Similarly, mount the following input coils.

MOUNT COIL	AT
40 meter (#40-592)	AD
20 meter (#40-593)	AL
15 meter (#40-594)	AK
10 meter (#40-595)	AJ



PICTORIAL 4

SUBCHASSIS WIRING

Refer to Pictorial 4 for the following steps.

NOTE: Only one end of the following three wires will be connected now. The other end will be connected later.

() Connect one end of a 13-1/2" green wire to lug 1 of terminal strip AB (NS). Position the other end of this wire as shown.

() Connect one end of an 11-1/2" blue wire to lug 5 of terminal strip AB (NS). Position the other end of this wire as shown.

() Connect one end of an 11-1/2" yellow wire to lug 6 of terminal strip AB (NS). Position the other end of this wire as shown.

Refer to the inset drawing on Pictorial 4 for the next four steps.

() Connect a .02 μfd disc capacitor between lugs 4 (NS) and 5 (NS) of terminal strip AB.

() Connect a .02 μfd disc capacitor between lugs 4 (NS) and 6 (NS) of terminal strip AB.

() Place a 3/8" length of sleeving on each lead of a .02 μfd disc capacitor. Connect this capacitor between lugs 1 (NS) and 4 (NS) of terminal strip AB.

() Place a 1/2" length of sleeving on each lead of an 18 μμf disc capacitor. Connect this capacitor between lugs 2 (NS) and 4 (S-4) of terminal strip AB.

() Connect the lead from the color band end of a silicon diode 1N458 (yellow-green-gray) to lug 1 (S-3) and the other lead of this diode to lug 2 (NS) of terminal strip AB.

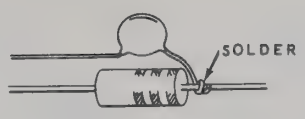
() Place a 5/8" length of sleeving on each lead of a 4700 Ω (yellow-violet-red) resistor. Connect this resistor between lugs 2 (NS) and 5 (S-3) of terminal strip AB.

() Connect a 3300 Ω (orange-orange-red) 1 watt resistor between lugs 3 (NS) and 6 (NS) of terminal strip AB. Position this resistor next to the chassis as shown.

() Connect a 28 μh RF choke (#45-18) between lugs 3 (NS) and 6 (S-4) of terminal strip AB.

() Place a 3/4" length of sleeving on each lead of a 33 Ω (orange-orange-black) 1 watt resistor. Connect this resistor from lug 3 of terminal strip AB (NS) to lug 3 of tube socket V2 (NS).

() Refer to Detail 4A and prepare a 33 Ω (orange - orange - black) 1 watt resistor and 5 μμf disc capacitor combination.



Detail 4A

() Place a 5/8" length of sleeving on the combined resistor and capacitor lead. Connect this lead to lug 3 of tube socket V1 (NS).

() Place a 5/8" length of sleeving on each lead at the other end of this combination. Then connect the resistor lead to lug 3 (S-4) and the capacitor lead to lug 2 (S-4) of terminal strip AB.

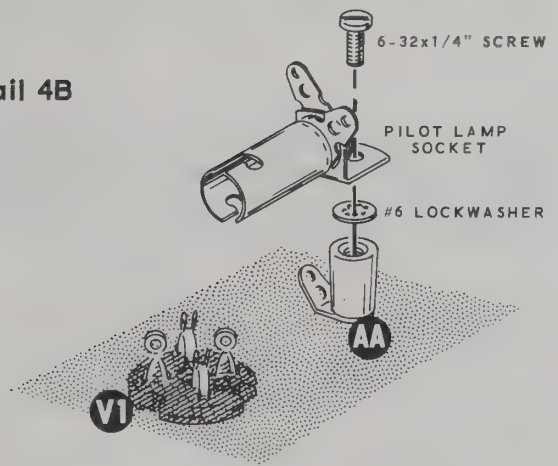
() Connect a 200 μμf resin capacitor from lug 3 of tube socket V1 (S-2) to solder lug AA (NS).

() Connect a 2-3/4" red stranded wire from lug 1 of tube socket V1 (S-1) to lug 4 of tube socket V2 (NS).

() Connect a .02 μfd disc capacitor between lugs 4 (S-2) and 2 (NS) of tube socket V2.

() Refer to Detail 4B and mount the pilot lamp socket on the spacer at AA. Use a 6-32 x 1/4" screw and one #6 lockwasher. Position the socket as shown in Pictorial 4.

Detail 4B



() Connect a 2-1/4" black wire from lug 2 of the pilot lamp socket (S-1) to solder lug AA (S-2).

() Connect a 470 μμf molded capacitor from lug 2 of coil AC (NS) to solder lug AF (NS).

() Connect a 510 μμf molded capacitor from lug 1 of coil AD (NS) to solder lug AF (NS).

() Connect a 310 μμf resin capacitor from lug 2 of coil AD (NS) to solder lug AF (S-3).

() Connect a 360 μμf resin capacitor from lug 2 of coil AL (NS) to solder lug AG (NS).

() Connect a 200 μμf resin capacitor from lug 1 of coil AL (NS) to solder lug AG (NS).

() Connect a 230 μμf resin capacitor from lug 2 of coil AK (NS) to solder lug AG (S-3).

() Connect a 115 μμf resin capacitor from lug 1 of coil AK (NS) to solder lug AH (NS).

() Connect a 290 μμf resin capacitor from lug 2 of coil AJ (NS) to solder lug AH (NS).

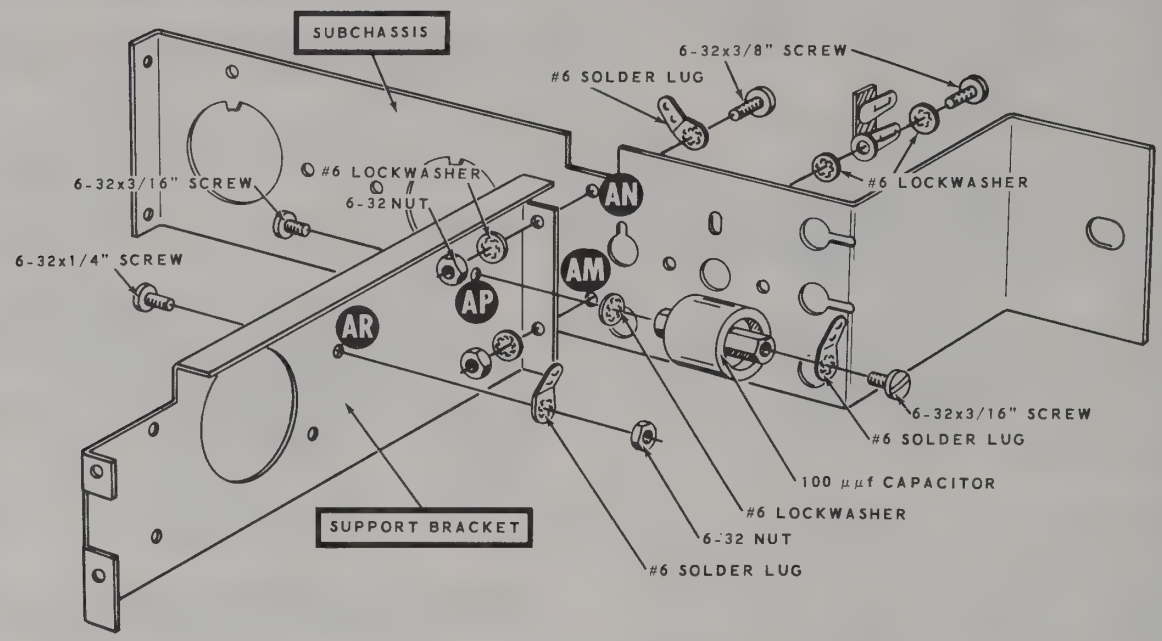
() Connect a 115 μμf resin capacitor from lug 1 of coil AJ (NS) to solder lug AH (S-3).

() Precut the following lengths of black wire. Then prepare each wire by removing 1/4" of insulation from each end. The wire lengths are listed in the order in which they will be used.

3"	2-3/4"	2-1/2"
1-1/2"	2-1/4"	2-1/4"
2-1/2"	2-1/2"	2-1/2"
1-3/4"		

In the following steps connect one end of the prepared black wire to the coil lug specified. Leave the other end free and position it as shown in the Pictorial. This end will be connected later.

CONNECT A	TO
() 3" wire	lug 1 of coil AJ (S-2).
() 1-1/2" wire	lug 2 of coil AJ (S-2).
() 2-1/2" wire	lug 1 of coil AK (S-2).
() 1-3/4" wire	lug 2 of coil AK (S-2).
() 2-3/4" wire	lug 1 of coil AL (S-2).
() 2-1/4" wire	lug 2 of coil AL (S-2).
() 2-1/2" wire	lug 2 of coil AD (S-2).
() 2-1/2" wire	lug 1 of coil AD (S-2).
() 2-1/4" wire	lug 2 of coil AC (S-2).
() 2-1/2" wire	lug 1 of coil AC (S-1).



PICTORIAL 5

NOTE: The tube sockets, coils, and other components were omitted from Pictorial 5 for clarity.

Refer to Pictorial 5 for the following steps.

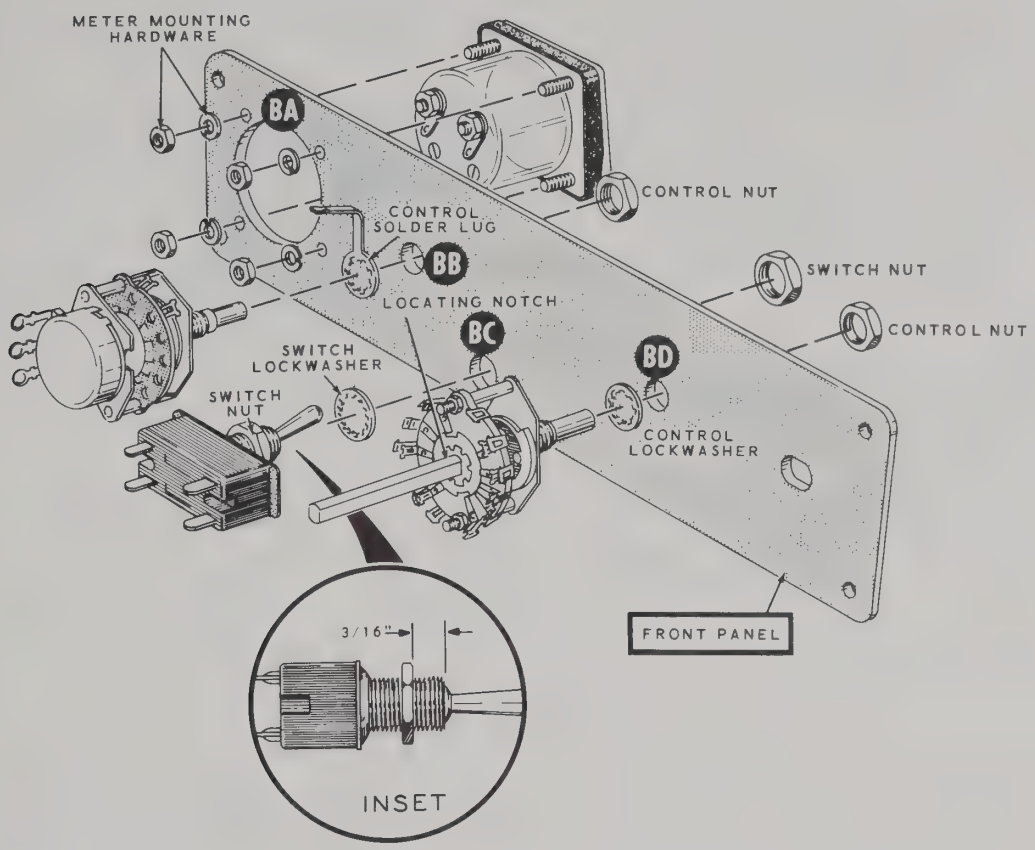
() Locate the support bracket and position it with the lip and cutouts as shown in Pictorial 5.

() Mount a #6 solder lug at AR with a 6-32 x 1/4" screw and 6-32 nut.

() Mount a 100 μμf capacitor at AP with a 6-32 x 3/16" screw and #6 lockwasher.

() Mount a #6 solder lug on top of the 100 μμf capacitor at AP with a 6-32 x 3/16" screw.

() Mount the support bracket to the subchassis with a 2-lug terminal strip at AM and a #6 solder lug at AN. Use 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.



PICTORIAL 6

Refer to Pictorial 6 for the following steps.

() Carefully remove the meter from its box and remove the shorting wire from between its terminals.

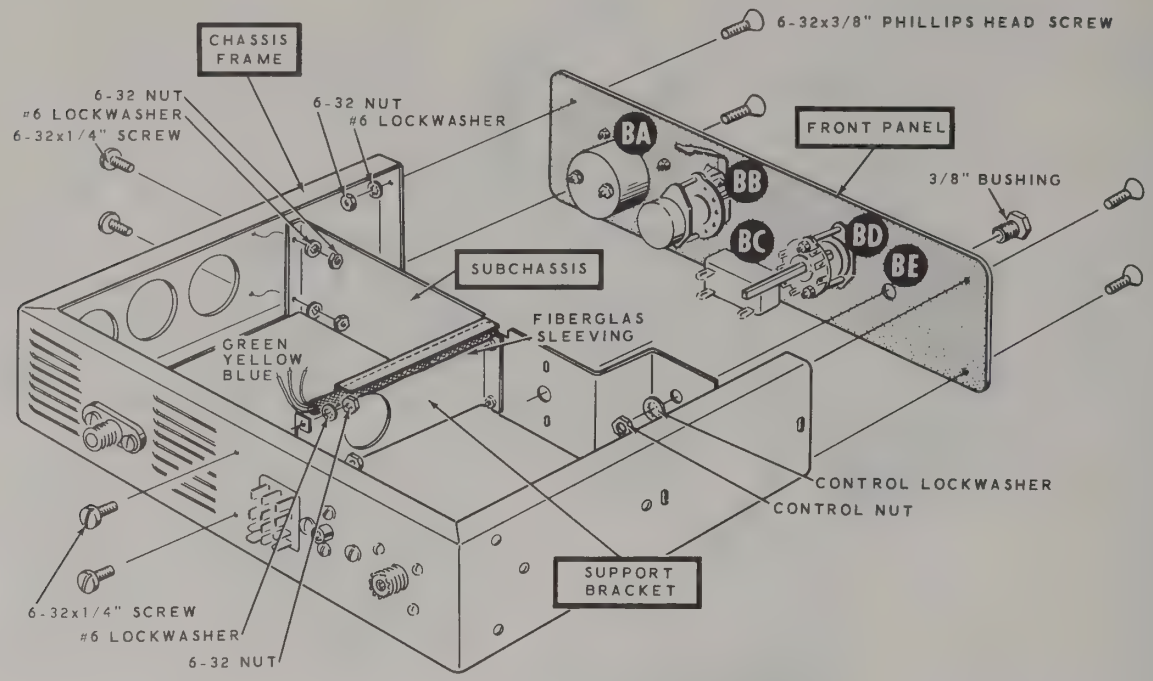
() Position the front panel on your work area as shown and mount the meter at BA. Be sure that the lettering is right side up and secure the meter with the meter mounting hardware supplied with the meter. Do not overtighten this hardware or you will damage the meter.

() Mount the switch-control (#63-381) at BB. Use a control solder lug, and control nut. Position the switch-control as shown.

() Remove one switch nut from the DPST toggle switch. Adjust the remaining switch nut until it is 3/16" from the end of the switch bushing. The ON position of the switch is marked on the front of the switch body. When mounting the switch, be sure the ON marking corresponds to the ON marking on the front panel. Mount this switch at BC with the switch lockwasher and the switch nut removed previously.

() Locate the 5-position 3-wafer rotary switch (#63-374). Be sure the switch shaft is turned fully counterclockwise when viewed from the front. Then remove the rear section.

() Mount the front portion of this switch at BD with a control lockwasher and control nut. Position the switch so that the locating notch on the wafer is as shown in Pictorial 6. The rear section will be installed later.



PICTORIAL 7

Refer to Pictorial 7 for the following steps.

() Position the subchassis and support bracket in the chassis frame as shown. Secure the subchassis and support bracket to the side and rear apron of the chassis base with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

() Mount the front panel on the chassis frame as shown in Pictorial 7. Secure each corner of the front panel with 6-32 x 3/8" phillips head screws, #6 lockwashers, and 6-32 nuts.

() Mount a 3/8" bushing at BE with a control lockwasher and control nut as shown.

() Place the free ends of the green, yellow, and blue wires extending from terminal strip AB, through the length of fiberglas sleeving. Position the fiberglas sleeving under the lip on the support bracket as shown in Pictorial 7.

Refer to Pictorial 8 (fold-out from Page 19) for the following steps.

() Connect a 7-1/4" black wire from lug 1 of pilot lamp socket AA (S-1) to lug 1 of terminal strip AM (NS).

() Connect a 3-1/4" black wire from lug 1 of meter BA (NS) to lug 1 of switch-control BB (NS).

() Connect a 2-1/4" black wire from lug 2 of meter BA (NS) to lug 2 of switch-control BB (S-1).

() Connect a .02 μfd disc capacitor between lugs 1 (S-2) and 2 (S-2) of meter BA. Position this capacitor as shown.

() Connect a 3" black wire from lug 1 of switch-control BB (S-2) to the solder lug mounted with BB (NS).

() Connect a 1-1/2" black wire from lug 3 of the switch (S-1) to lug 3 of the control (S-1) of switch-control BB.

() Connect a 200 μμf resin capacitor from lug 3 of tube socket V2 (S-2) to solder lug AN (S-1).

The following steps concern the connection of the free end of the wires extending from coils AC, AD, AJ, AK, and AL.

NOTE: In most cases switch BD has a lug on each side of the wafer at each location. Whenever a wire is connected, place the wire through both lugs and solder both lugs to the wire.

CONNECT THE WIRE FROM	TO LUG OF SWITCH BD
() 1 of coil AJ	2 (S-1).
() 1 of coil AK	3 (S-1).
() 1 of coil AL	4 (S-1).
() 2 of coil AD	5 (S-1).
() 2 of coil AC	6 (S-1).
() 2 of coil AJ	8 (S-1).
() 2 of coil AK	9 (S-1).
() 2 of coil AL	10 (S-1).

NOTE: The wires from lug 1 of coils AC and AD will be connected later.

() Referring to Detail 8A, prepare an 11-1/2" length of RG-58 coaxial cable (large).

() Place the 1" prepared end of this coaxial cable through the fiberglas sleeving from the front of the chassis. Position the cable so the 1" prepared end reaches relay F on the rear apron.

() At the 1-1/2" prepared end of this coaxial cable, connect the inner lead to lug 7 of switch BD (S-1) and the shield lead to solder lug AE (S-1). The other end will be connected later.

() Remove 1/4" of insulation from one end and 1/2" from the other end of a 10" red wire. Place the 1/2" end of this wire through the fiberglas sleeving as shown.

() Connect the 1/4" stripped end of this wire to lug 1 of terminal strip AM (NS). The other end will be connected later.

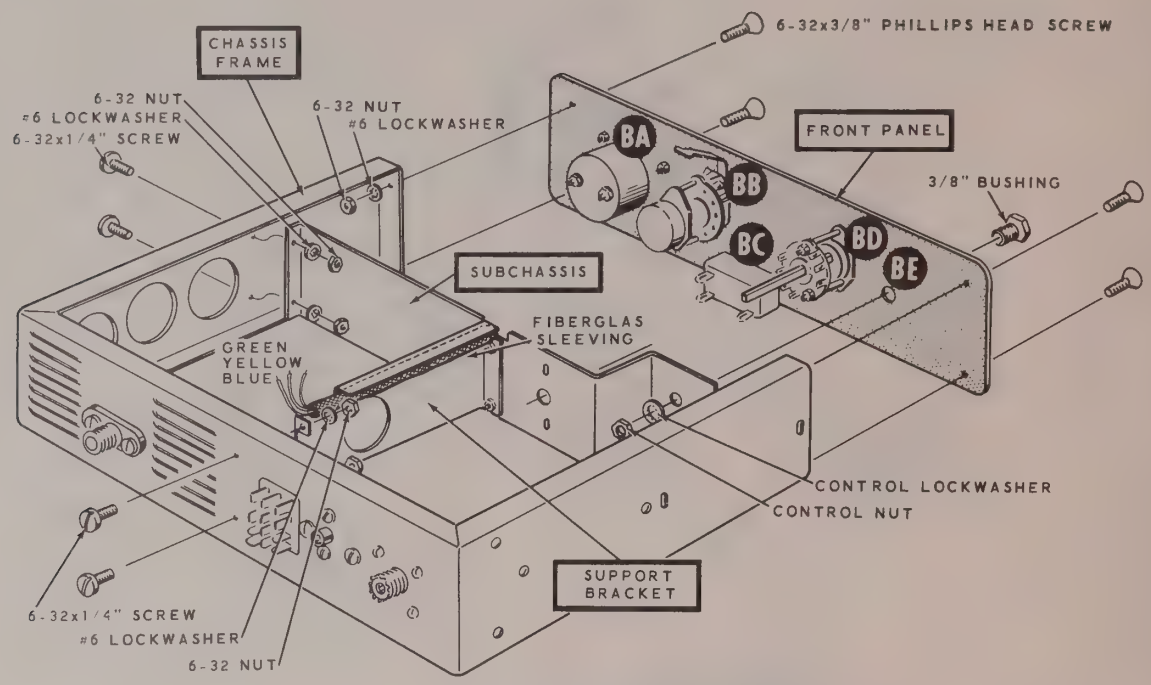
() Referring to Detail 8B, prepare both ends of a 17-1/2" and a 14-1/4" RG-174 coaxial cable (small).

() Place these two cables through the fiberglas sleeving as shown.

() Connect the inner lead of the 14-1/4" shielded cable to lug 12 of switch BB (S-1) and the shield lead to the control solder lug at BB (NS).

() Connect the inner lead of the 17-1/2" shielded cable to lug 11 of switch BB (S-1) and the shield lead to the control solder lug at BB (S-3).

() Install the pilot lamp in pilot lamp socket AA.



PICTORIAL 7

Refer to Pictorial 7 for the following steps.

() Position the subchassis and support bracket in the chassis frame as shown. Secure the subchassis and support bracket to the side and rear apron of the chassis base with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

() Mount the front panel on the chassis frame as shown in Pictorial 7. Secure each corner of the front panel with 6-32 x 3/8" phillips head screws, #6 lockwashers, and 6-32 nuts.

() Mount a 3/8" bushing at BE with a control lockwasher and control nut as shown.

() Place the free ends of the green, yellow, and blue wires extending from terminal strip AB, through the length of fiberglas sleeving. Position the fiberglas sleeving under the lip on the support bracket as shown in Pictorial 7.

Refer to Pictorial 8 (fold-out from Page 19) for the following steps.

() Connect a 7-1/4" black wire from lug 1 of pilot lamp socket AA (S-1) to lug 1 of terminal strip AM (NS).

() Connect a 3-1/4" black wire from lug 1 of meter BA (NS) to lug 1 of switch-control BB (NS).

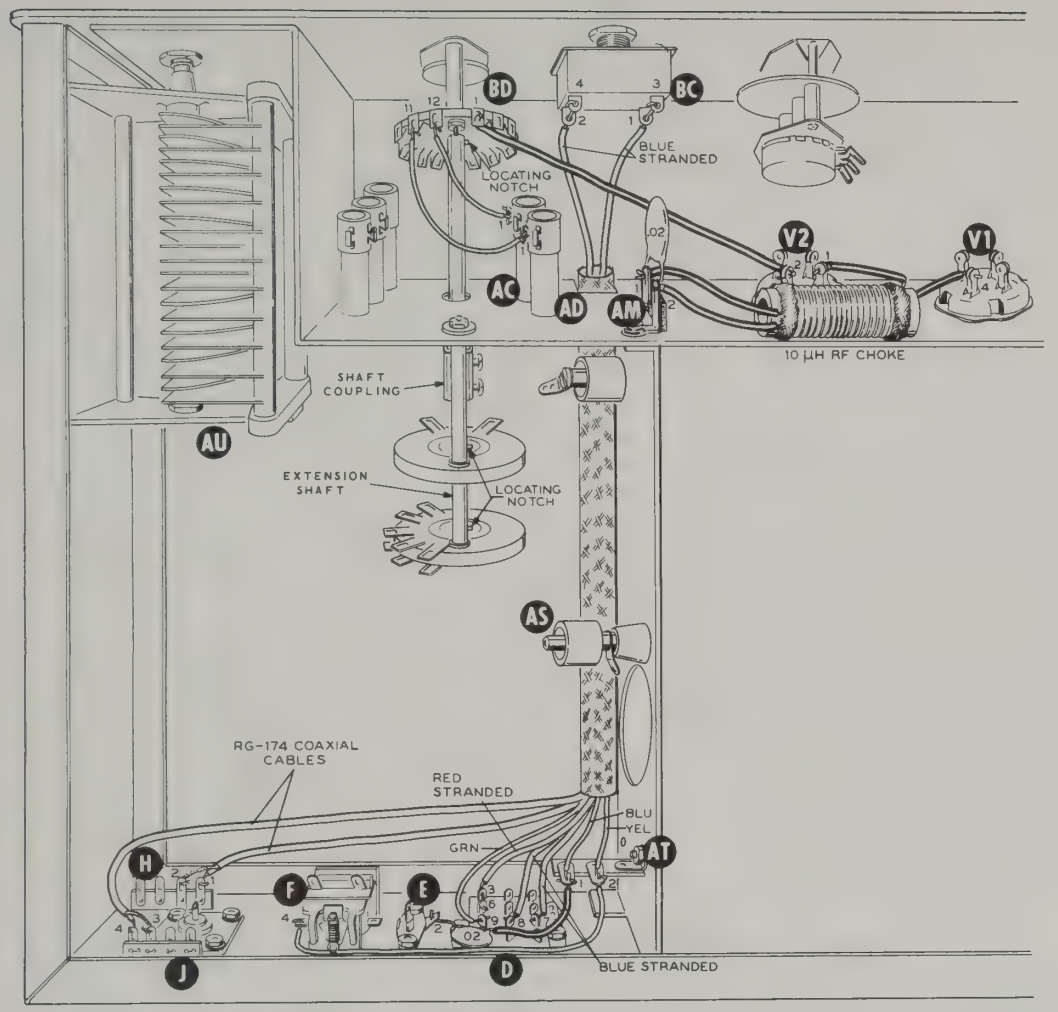
() Connect a 2-1/4" black wire from lug 2 of meter BA (NS) to lug 2 of switch-control BB (S-1).

() Connect a .02 μfd disc capacitor between lugs 1 (S-2) and 2 (S-2) of meter BA. Position this capacitor as shown.

() Connect a 3" black wire from lug 1 of switch-control BB (S-2) to the solder lug mounted with BB (NS).

() Connect a 1-1/2" black wire from lug 3 of the switch (S-1) to lug 3 of the control (S-1) of switch-control BB.

() Connect a 200 μμf resin capacitor from lug 3 of tube socket V2 (S-2) to solder lug AN (S-1).



PICTORIAL 9

Refer to Pictorial 9 for the following steps.

() Turn the chassis over and position it as shown in Pictorial 9.

() Connect the free end of the wire extending from lug 1 of coil AD to lug 11 of switch BD (S-1).

() Connect the free end of the wire extending from lug 1 of coil AC to lug 12 of switch BD (S-1).

() Remove 1/2" of insulation from one end of two 12" blue stranded wires and 1/4" of insulation from the other end of each cable.

() Place the 1/4" prepared end of these wires through the fiberglas sleeving starting at the subchassis end as shown in Pictorial 9.

() Place the 1/2" prepared end of either blue stranded wire through lug 2 (S-2) to lug 4 (S-1) of switch BC.

() Place a 1/2" prepared end of the other blue stranded wire through lug 1 (S-2) to lug 3 (S-1) of switch BC.

() Connect a 3-1/4" red stranded wire from lug 2 of tube socket V2 (S-2) to lug 1 of switch BD (S-1).

() Locate the 10 µh RF choke (#45-60) and place a 1-1/4" length of sleeving on each lead.

() Position the choke on the subchassis as shown in Pictorial 9. Then connect the lead nearest tube socket V2 to lug 1 of V2 (S-1).

() Connect the lead nearest tube socket V1 to lug 4 of V1 (S-1).

() At the other end of this choke, connect either lead to lug 1 (NS) and the other lead to lug 2 (NS) of terminal strip AM.

() Connect a .02 µfd disc capacitor between lugs 1 (S-4) and 2 (S-2) of terminal strip AM.

() Temporarily mount the 2-lug vertical terminal strip at AT. Use a 6-32 x 3/8" screw, two #6 lockwashers, and a 6-32 nut.

The free ends of the wires extending from the end of the fiberglas sleeving near the rear apron will be connected in the following steps.

() Connect the red stranded wire through lug 3 (S-2) to lug 6 (S-1) of power plug D.

() Connect either blue stranded wire to lug 7 (S-1) and the other blue stranded wire to lug 8 (S-1) of power plug D.

() Connect the green wire to lug 9 of power plug D (S-1).

() Connect the yellow wire to lug 2 of terminal strip AT (NS).

() Connect the blue wire to lug 1 of terminal strip AT (NS).

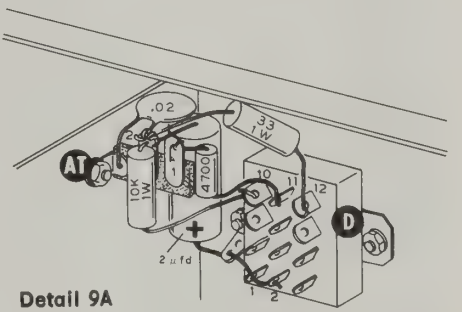
() Connect the inner lead at the free end of the shorter RG-174 coaxial cable (small) to lug 1 (S-3) and the shield lead to lug 2 (NS) of terminal strip H.

() Connect the inner lead at the free end of the remaining RG-174 coaxial cable (small) to lug 4 (S-3) and the shield lead to lug 3 (S-3) of terminal strip J.

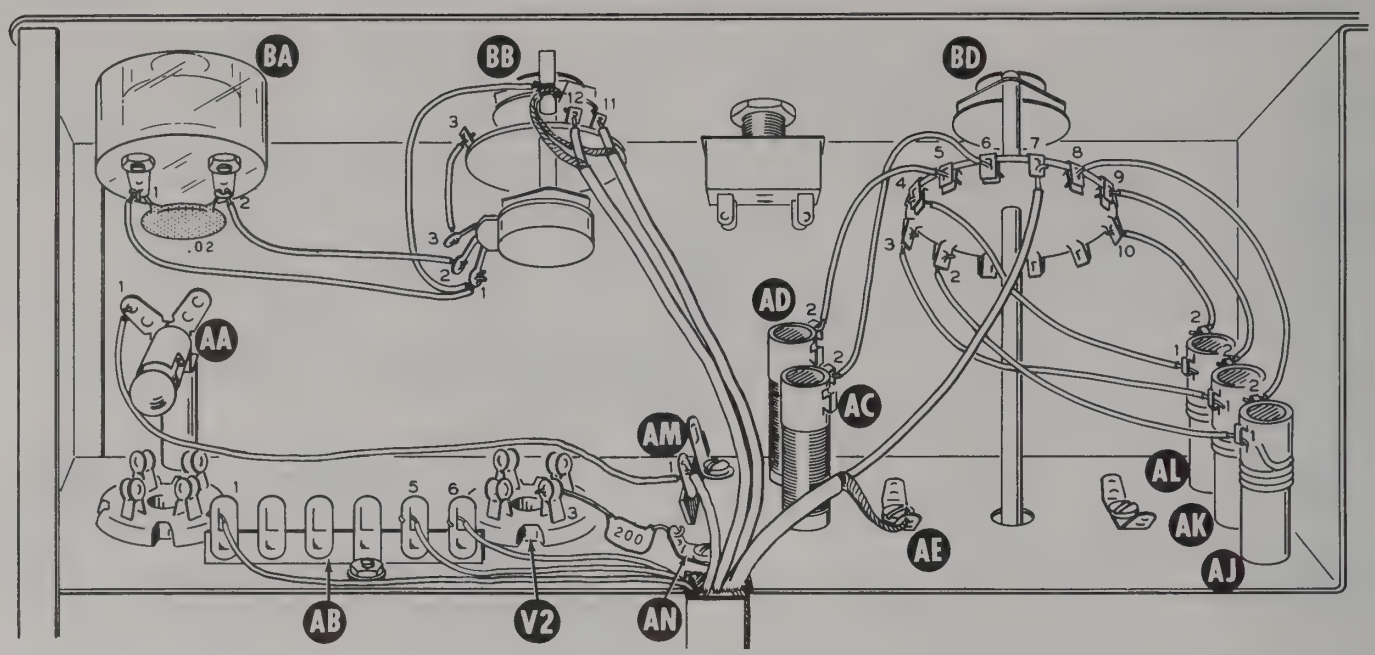
Refer to Detail 9A for the following steps.

() Place the positive (+) lead of a 2 µfd electrolytic capacitor through the solder lug mounted on power plug D (S-2), through lug 1 (S-2) to lug 2 (S-1) of power plug D. Connect the other lead of this capacitor to lug 2 of terminal strip AT (NS).

() Connect a 4700 Ω (yellow-violet-red) resistor from lug 1 of terminal strip AT (NS) to lug 11 of power plug D (S-1).

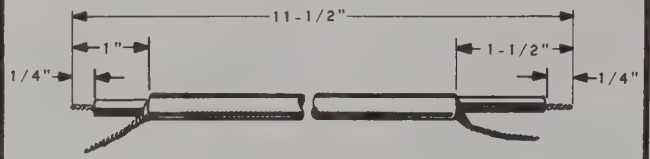


Detail 9A



PICTORIAL 8

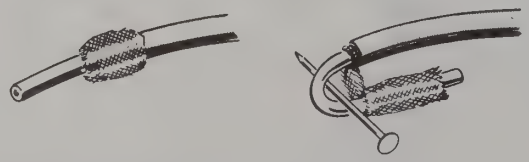
CUT THE CABLE ACCORDING TO THE DIMENSIONS BELOW. PREPARE EACH END AS SHOWN.



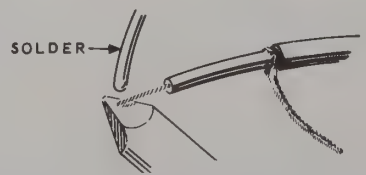
TAKING CARE NOT TO CUT THE OUTER SHIELD OF VERY THIN WIRES, REMOVE THE OUTER INSULATION.



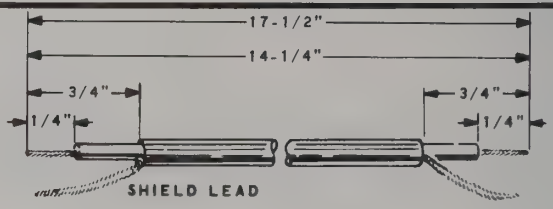
PUSH BACK THE SHIELD. THEN MAKE AN OPENING IN THE SHIELD AND BEND OVER AS SHOWN. PICK OUT THE INNER LEAD.



REMOVE THE INNER INSULATION AND STRETCH OUT THE SHIELD. APPLY A SMALL AMOUNT OF SOLDER TO THE END OF THE SHIELD AND THE INNER LEAD. USE ONLY ENOUGH HEAT FOR THE SOLDER TO FLOW.



Detail 8A



TAKING CARE NOT TO CUT THE VERY THIN WIRES OF THE SHIELD LEAD, REMOVE THE OUTER INSULATION.



PEEL OFF THE FOIL AND STRAIGHTEN OUT THE THIN WIRES OF THE SHIELD LEAD.



REMOVE THE INNER INSULATION AND TWIST THE SMALL WIRES OF THE SHIELD LEAD. APPLY SMALL AMOUNTS OF SOLDER TO THE END OF THE SHIELD LEAD AND THE INNER LEAD.



Detail 8B

() Connect a 33 Ω (orange-orange-black) 1 watt resistor from lug 2 of terminal strip AT (NS) to lug 12 of power plug D (S-2).

() Connect a .02 μfd disc capacitor between lug 2 (NS) and the hole in the mounting foot (S-1) of terminal strip AT.

() Connect a 10 KΩ (brown-black-orange) 1 watt resistor from lug 2 of terminal strip AT (NS) and lug 10 of power plug D (S-2).

Refer to Pictorial 9 for the following steps.

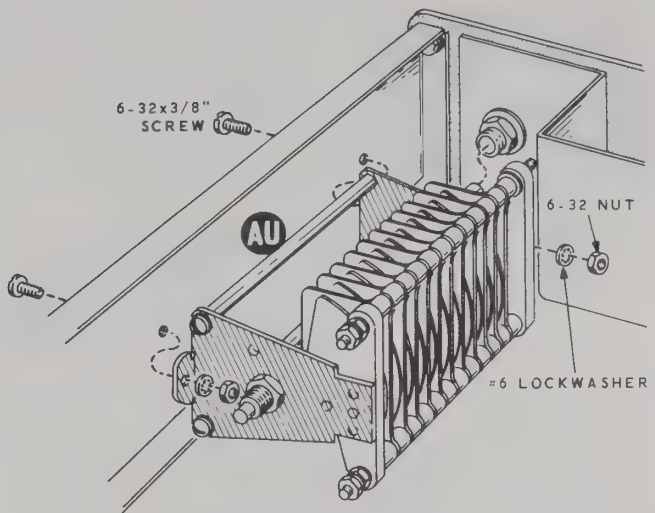
() Place a 1/2" length of sleeving on one lead of a .02 μfd disc capacitor. Connect this lead to lug 1 of terminal strip AT (S-3).

() Connect the other lead of this capacitor to lug 2 of phono socket E (S-2).

() Connect a 5" yellow wire from lug 2 of terminal strip AT (S-6) to lug 4 of relay F (S-1).

() Refer to Detail 9B and mount the variable capacitor (#26-96) at AU. Use 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts. NOTE: The mounting holes for variable capacitor AU and the bushing hole in the front panel are slotted. Adjust the capacitor and bushing so that the capacitor shaft turns freely.

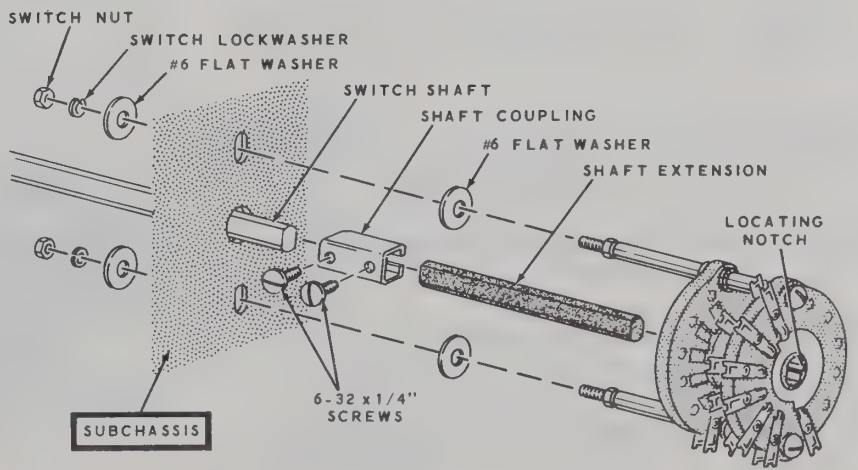
() Start two 6-32 x 1/4" screws in the shaft coupling. Refer to Detail 9C. Install one end of the shaft coupling on the Band switch shaft, and the other end of the coupling on the extension shaft.



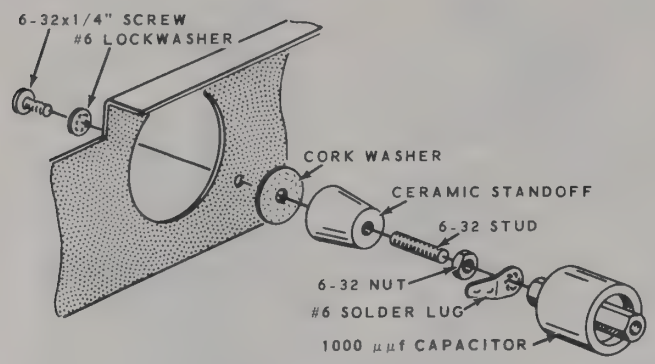
Detail 9B

() Locate the rear section of the 5-position switch (#63-374). Remove one nut and a lockwasher from each switch stud. Mount the rear switch section to the subchassis as shown in Detail 9C. Position the switch lugs and locating notch as shown in Pictorial 9. Secure the switch section with #6 flat washers and the nuts and lockwashers removed previously.

() Start a setscrew in one of the knobs and install this knob on the shaft of the BAND switch. Rotate the switch shaft. If it does not turn freely, adjust the rear section of the switch for free movement of the switch shaft. When the switch is turned full counterclockwise, the knob pointer should be at 80 on the front panel.



Detail 9C



Detail 9D

() Referring to Detail 9D, screw the 6-32 stud into a 1000 μμf (.001 μfd) tubular capacitor. Place a #6 solder lug over the stud and secure it with a 6-32 nut. Hold the base of the capacitor with long-nose pliers and tighten the nut securely.

() Remove the hardware from the top of the ceramic insulator and discard it. Screw the 6-32 stud installed in the previous step into the top of the ceramic insulator.

() Mount the ceramic insulator and capacitor at AS with a 6-32 x 1/4" screw, a #6 lockwasher and the cork washer supplied with the insulator. Position the solder lug as shown in Pictorial 9. Discard the screw and flat washer supplied with the insulator.

Refer to Pictorial 10 (fold-out from Page 27) and Detail 10A for the following steps.

() Mount a #6 solder lug at AV on the input shield (#206-M275). Use a 6-32 x 1/4" screw and a 6-32 nut.

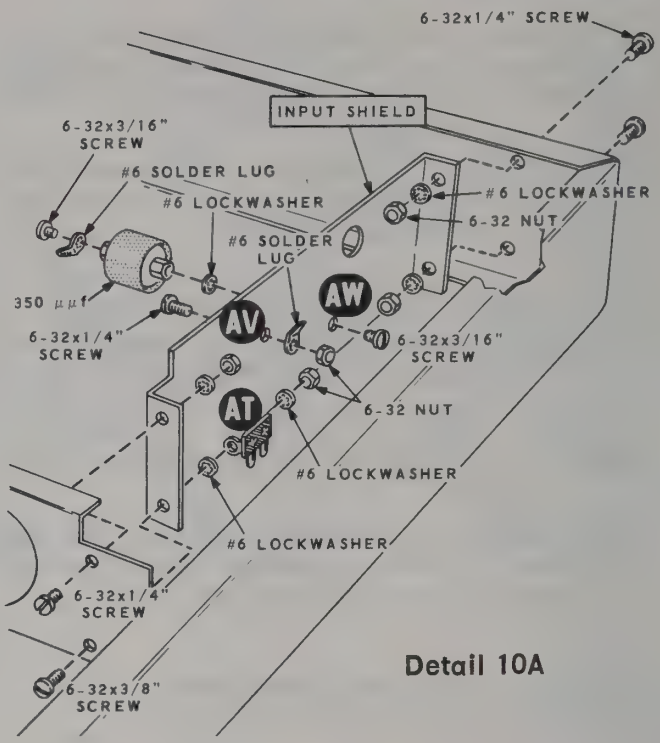
() Mount a 350 μμf tubular capacitor at AW with a 6-32 x 3/16" screw, and a #6 lockwasher.

() Mount a #6 solder lug on top of capacitor AW. Use a 6-32 x 3/16" screw.

() Turn the chassis over and position it as shown in Pictorial 10.

() Temporarily remove the hardware securing terminal strip AT.

() Mount the input shield on the chassis as shown in Detail 10A and Pictorial 10.

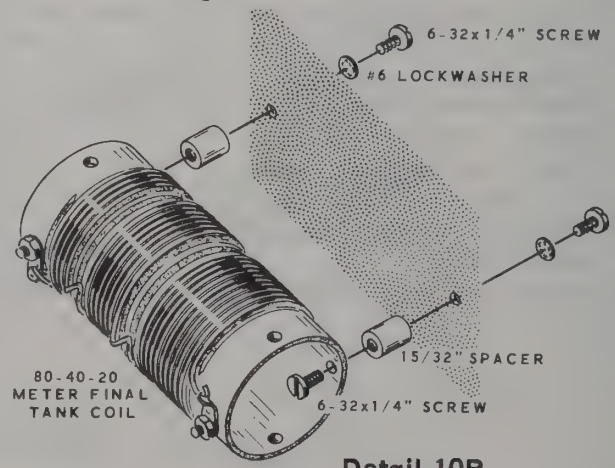


Detail 10A

Secure the input shield and terminal strip at AT with the hardware removed previously. Secure the remaining three corners of the input shield with 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

() Locate the 80, 40, and 20 meter output tank coil (#40-597) and mount a 15/32" spacer on each end as shown in Detail 10B. Use 6-32 x 1/4" screws.

() Referring to Detail 10B, mount the 80, 40, and 20 meter output tank coil at AX with 6-32 x 1/4" screws and #6 lockwashers. Position the end with the four turn coil near variable capacitor AU.



Detail 10B

() Connect the shield lead of the RG-58 coaxial cable, extending from the fiberglas sleeving, to solder lug AV (S-1) and the inner lead to lug 7 of relay F (S-1).

() Connect a 1-1/8" bare wire between lugs 5 (S-1) and 6 (S-1) of relay F. Be sure this lead does not touch the metal input shield.

() Place one end of a 2-1/2" bare wire through the large hole in the input shield, through lug 1 of coil AX (S-2) to solder lug on capacitor AW (NS). Connect the other end of this wire to lug 8 of relay F (S-1).

() Wrap one lead of a 1.1 mh choke around the wire connected to lug 8 of relay F (S-1). Connect the other lead to lug 2 of terminal strip H (S-4).

NOTE: The bare wire is too large to fit into the switch lugs. Therefore the end going to the switch lugs should be flattened as shown in Detail 10C. Pass the wire through both lugs at each position on the switch. Do not attempt to bend this wire around the coil or switch lugs as the coil or switch could be damaged. When soldering connections at switch BD, be sure to solder both lugs at each connection.

() Connect a bare wire from lug 4 of coil AX (S-1) to lug 9 on wafer C of switch BD (NS). Pass the wire through both lugs of the switch and let it extend 1/4" beyond the switch lug.

() Position the 10 and 15 meter final tank coil behind switch BD as shown in Pictorial 10. Secure the end of the coil with the mounting lug to capacitor AS with a #6 solder lug and 6-32 x 3/16" screw.

() Connect the other end of the 10 and 15 meter final tank coil to lug 9 on wafer C of switch BD (NS). Place the coil wire between the two lugs. Bend the 1/4" lead of the bare wire extending from lug 9 as shown in the inset drawing and solder lug 9 (S-2).

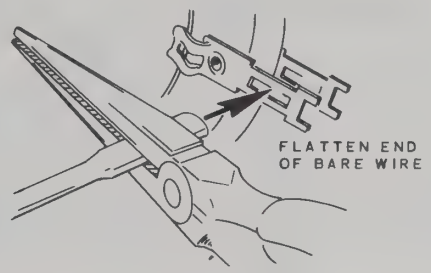
() Connect the lead extending from the center of the 10 and 15 meter final tank coil to lugs 8 on wafer C of switch BD (S-1).

() Place a #6 solder lug on bolt 1 of variable capacitor AU. Secure the solder lug with a 6-32 nut.

() Connect a bare wire from lug 1 of variable capacitor AU (S-1) to lug 8 of wafer B on switch BD (S-1).

() Connect a 1" bare wire from lug 5 on wafer B of switch BD (S-1) to capacitor AP (S-1).

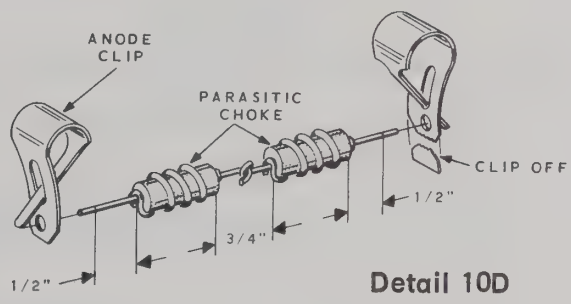
() Connect a 500 $\mu\mu$f molded capacitor from lug 6 on wafer C of switch BD (S-1) to solder lug AR (S-1).



Detail 10C

() Cut off the end of each anode clip as shown in Detail 10D.

() Referring to Detail 10D, connect the two parasitic chokes in series. Connect the free end of each choke to an anode clip and solder the connection.



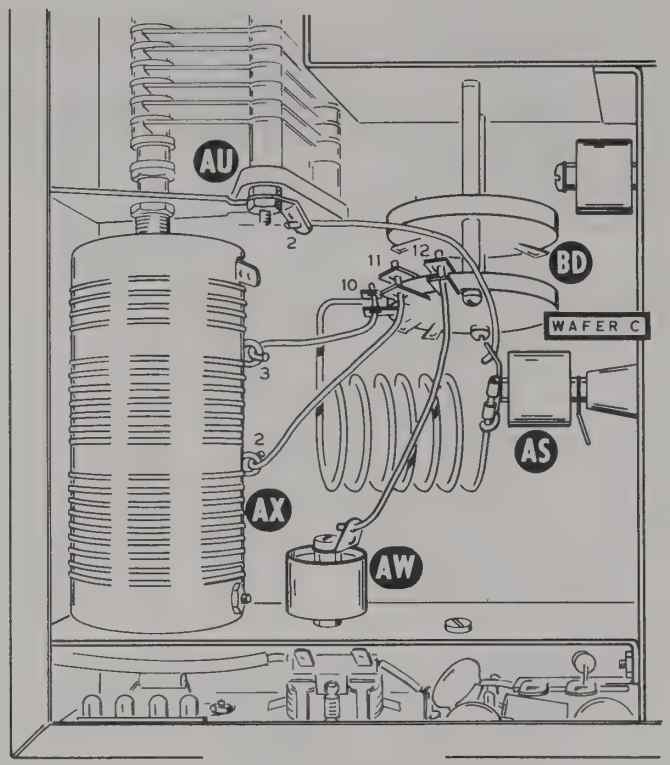
Detail 10D

() Install the two tubes in tube sockets V1 and V2. The two large tube base pins fit into the large tube socket holes. Snap the tube clamps around the bases of the tubes.

() Install the anode clip on the plate caps of the tubes.

() Connect a 3-1/2" bare wire from lug 2 of RF choke C (NS) to the solder lug between the ceramic insulator and 1000 $\mu\mu$f capacitor at AS (S-1). CAUTION: Be sure this wire does not touch the metal support bracket.

() Connect a 3" bare wire from lug 2 of RF choke C (S-2) to the point between the two parasitic chokes as shown in Pictorial 10. Crimp this wire tightly and solder the connection.



PICTORIAL 11

Refer to Pictorial 11 for the following steps.

() Turn the chassis over and position it as shown in Pictorial 11.

() Connect a 1-3/4" bare wire from lug 3 of coil AX (S-1) to lug 10 on wafer C of switch BD (S-1).

() Connect a 2-1/2" bare wire from lug 2 of coil AX (S-1) to lug 11 on wafer C of switch BD (S-1).

() Connect a 3" bare wire from capacitor AW (S-2) to lug 12 on wafer C of switch BD (S-1).

() Mount a #6 solder lug on lug 2 of variable capacitor AU. Secure the solder lug with a 6-32 nut.

() Connect a 3" bare wire from lug 2 of variable capacitor AU (S-1) to the solder lug on capacitor AS (S-1).

This completes the assembly of your Heathkit HA-14 SSB Linear Amplifier. Shake out all wire clippings and solder splashes. Check to be sure all connections have been properly soldered.

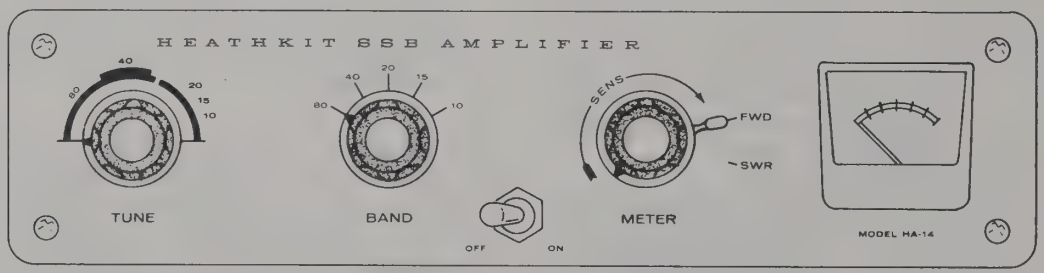
Refer to Pictorial 12 for the following steps.

() Start setscrews into the remaining two knobs.

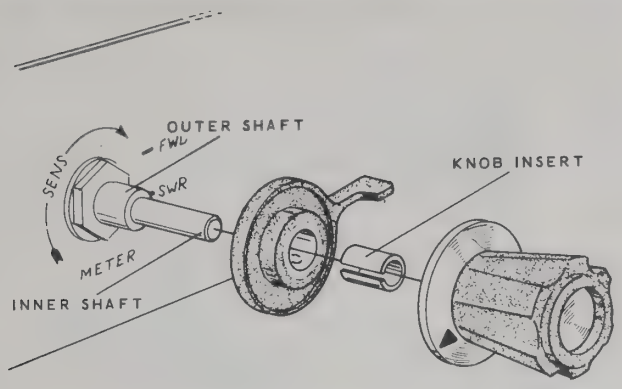
() Turn the TUNE capacitor until the plates are fully meshed. Install a knob on the TUNE capacitor shaft with the pointer at the 9 o'clock position.

Refer to Detail 12A for the following steps.

() Turn the outer shaft on the METER control fully counterclockwise. Install the lever knob on the outer shaft with the pointer at FWD. Tighten the setscrew with the allen wrench supplied. Do not overtighten or the outer shaft will bend causing the shafts to bind.



PICTORIAL 12

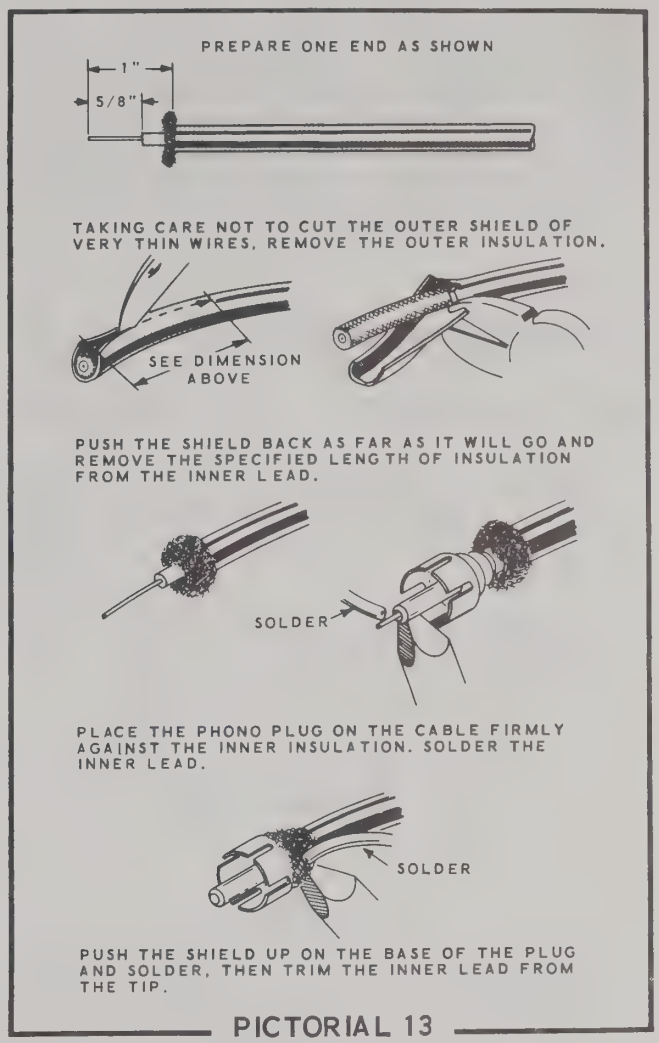


Detail 12A

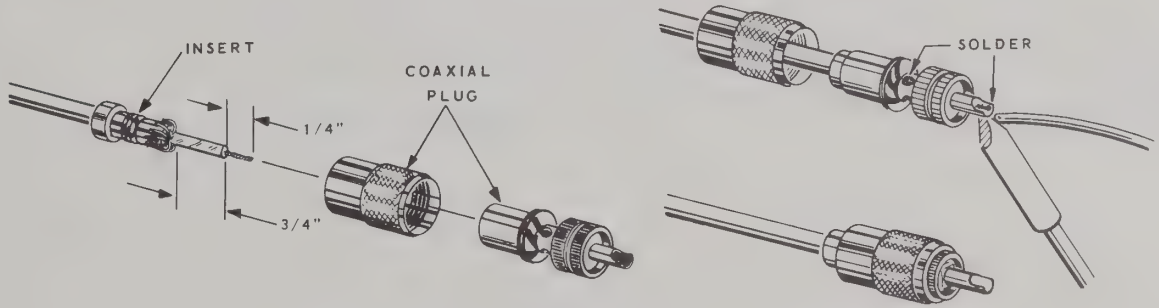
() Turn the inner shaft of the METER control fully counterclockwise. Place the knob insert in the remaining knob and install the knob on the inner shaft of the METER control. Set the pointer at the 7 o'clock position.

() Referring to Pictorial 13 prepare a length of RG-58 coaxial cable long enough to reach from the RF output of the exciter to the RF INPUT of the Linear Amplifier. Install a phono plug on one end and the proper connector to match your exciter output on the other end.

NOTE: If it is necessary to install a coaxial connector to any of the cables, refer to Pictorial 14 for proper installation.



PICTORIAL 13



PICTORIAL 14

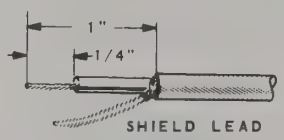
NOTE: The following steps concern the power socket wiring for the Linear Amplifier. Pictorial 15 shows the correct wiring for DC operation and Pictorial 16 shows the correct wiring for use with the AC power supply. If both plugs are wired, they should be labeled to avoid mixing them after they are wired.

DC POWER SOCKET WIRING

Refer to Pictorial 15 for the following steps.

() Cut two lengths of the RG-174 coaxial cable. These cables must be long enough to reach from the Linear Amplifier to the exciter.

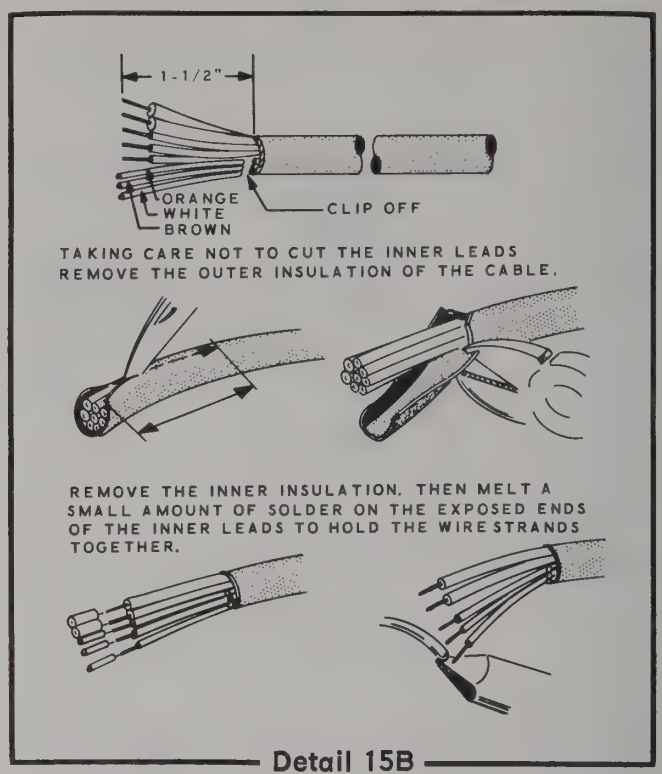
() Prepare one end of each of these cables as shown in Detail 15A.



Detail 15A

() Prepare the free end of the 8-wire cable from the mobile power supply as shown in Detail 15B. Cut the orange, white, and brown wires off as they are not used.

() Place the free end of this 8-wire cable and the two RG-174 coaxial cables through the hole in the top of the female power socket cover.



Detail 15B

Connect the wires at the prepared end of the 8-wire cable as follows:

() Black through lug 1 (S-2) to lug 2 (S-1).

() Red through lug 6 (S-2) to lug 3 (S-1).

() Blue to lug 8 (S-1).

() Yellow to lug 9 (S-1).

() Green to lug 10 (S-1).

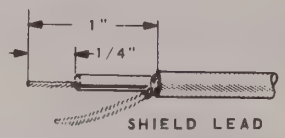
NOTE: The following steps concern the power socket wiring for the Linear Amplifier. Pictorial 15 shows the correct wiring for DC operation and Pictorial 16 shows the correct wiring for use with the AC power supply. If both plugs are wired, they should be labeled to avoid mixing them after they are wired.

DC POWER SOCKET WIRING

Refer to Pictorial 15 for the following steps.

() Cut two lengths of the RG-174 coaxial cable. These cables must be long enough to reach from the Linear Amplifier to the exciter.

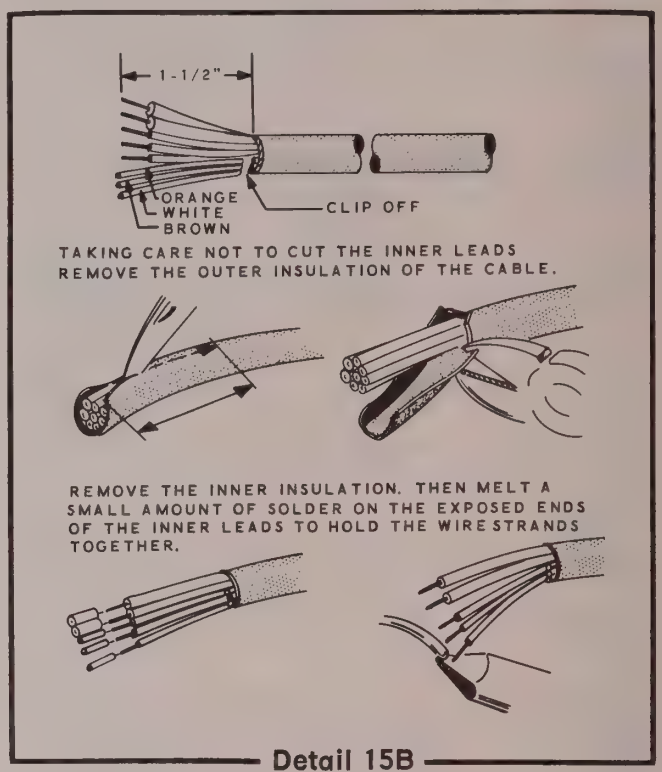
() Prepare one end of each of these cables as shown in Detail 15A.



Detail 15A

() Prepare the free end of the 8-wire cable from the mobile power supply as shown in Detail 15B. Cut the orange, white, and brown wires off as they are not used.

() Place the free end of this 8-wire cable and the two RG-174 coaxial cables through the hole in the top of the female power socket cover.



Detail 15B

Connect the wires at the prepared end of the 8-wire cable as follows:

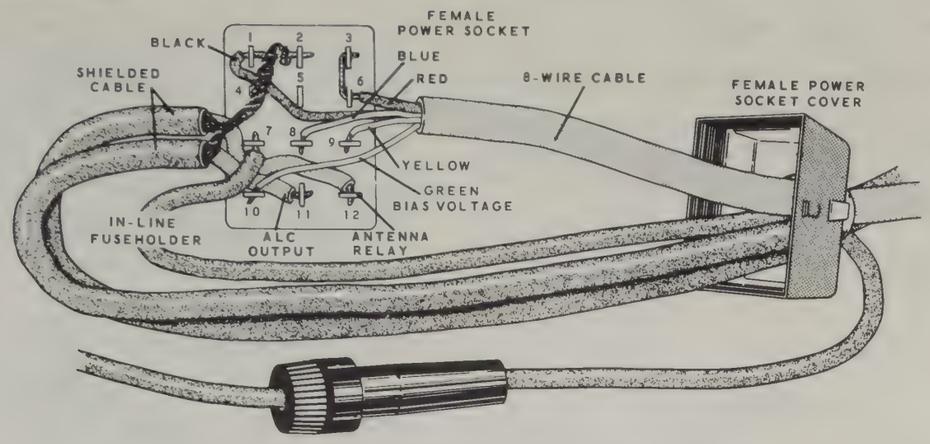
() Black through lug 1 (S-2) to lug 2 (S-1).

() Red through lug 6 (S-2) to lug 3 (S-1).

() Blue to lug 8 (S-1).

() Yellow to lug 9 (S-1).

() Green to lug 10 (S-1).



PICTORIAL 15

() Connect the inner lead of either coaxial cable to lug 12 (S-1) and the shielded lead to the wire between lugs 1 and 2 (NS). Mark this lead as the Antenna Relay lead.

() Connect the inner lead of the remaining coaxial cable to lug 11 (S-1) and the shield lead to the wire between lugs 1 and 2 (S-2). Mark this lead as the ALC lead.

() Locate the in-line fuseholder supplied with the HP-14 Power Supply. Cut the lead extending from the body end of the fuseholder to 8" and remove 1/4" of insulation.

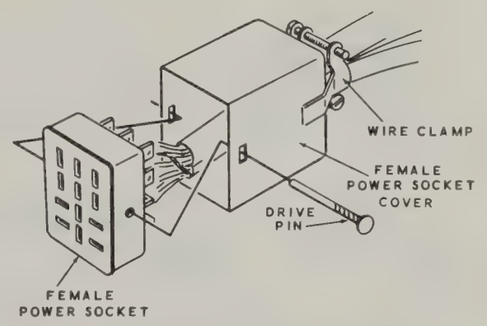
() Place this prepared end of the fuseholder lead through the hole in the top of the female socket cover. Connect this lead to lug 7 of the power socket (S-1). The other end of this wire is connected to the automobile ignition switch. See the HP-14 Manual.

() Refer to Detail 15C and place the female power socket into the socket cover. Line up the small holes in the socket cover with the holes in the socket. Insert the drive pin through the holes and lightly tap it in place.

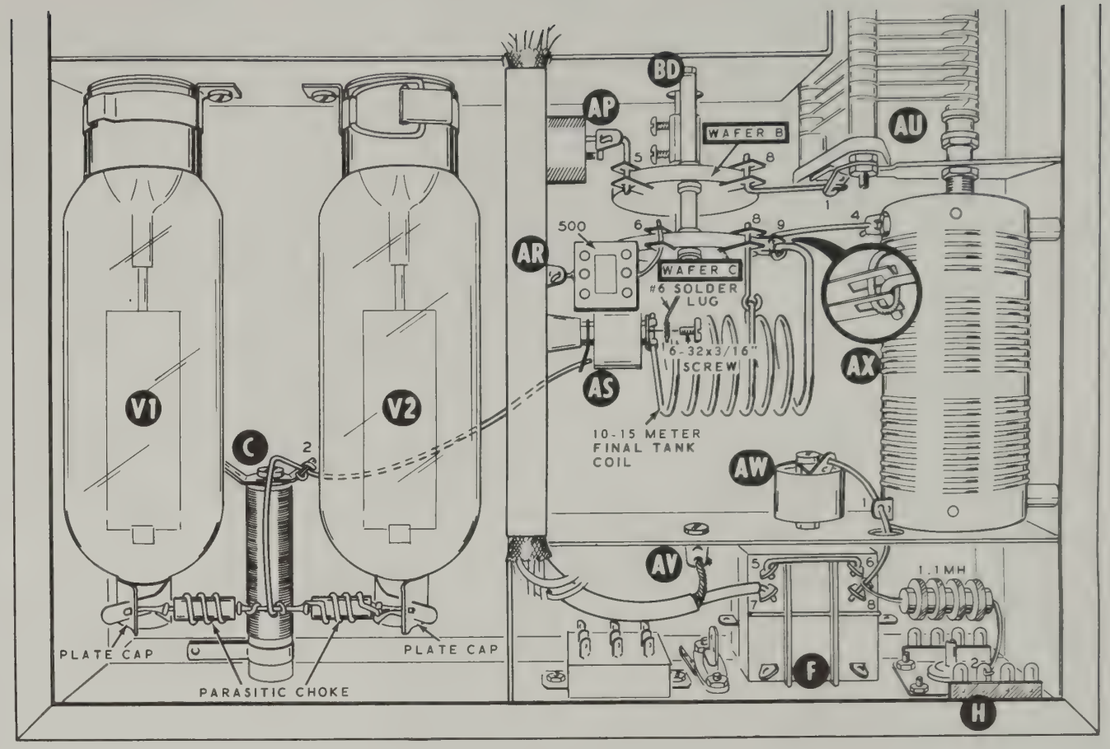
() Tighten the screws on the socket cover clamp to secure the cables.

() Install a phono plug or appropriate connector on the free end of the RG-174 coaxial cables extending from the power socket.

() Mount the high voltage cap on the free end of the high voltage wire coming from the DC Power Supply.



Detail 15C



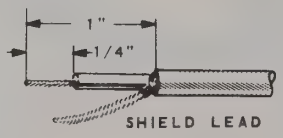
PICTORIAL 10

AC POWER SOCKET WIRING

Refer to Pictorial 16 for the following steps.

() Cut two lengths of the RG-174 coaxial cable. These cables must be long enough to reach from the Linear Amplifier to the exciter.

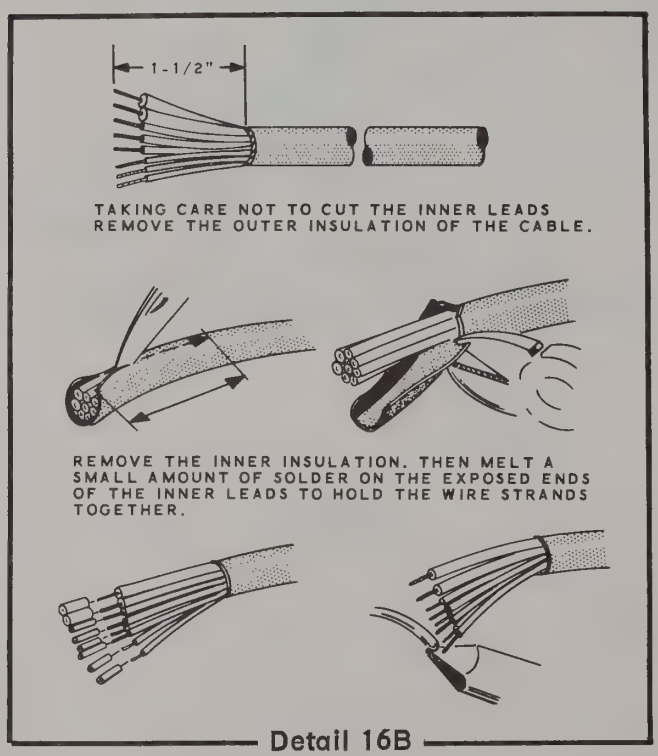
() Prepare one end of each of these cables as shown in Detail 16A.



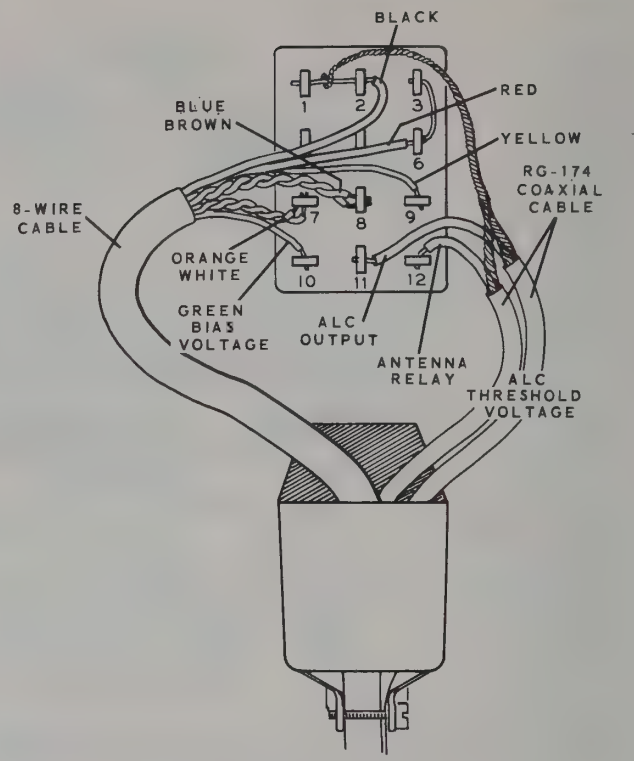
Detail 16A

() Prepare the free end of the 8-wire cable from the AC Power Supply as shown in Detail 16B.

() Place the free end of the 8-wire cable and the RG-174 coaxial cables through the hole in the top of the female power socket cover.



Detail 16B



PICTORIAL 16

Connect the wires at the prepared end of the 8-wire cable as follows:

() Black through lug 2 (S-2) to lug 1 (S-1).

() Red through lug 6 (S-2) to lug 3 (S-1).

() Yellow to lug 9 (S-1).

() Twist the blue and brown wires together and connect both wires to lug 8 (S-2).

() Twist the orange and white wires together and connect both wires to lug 7 (S-2).

() Green to lug 10 (S-1).

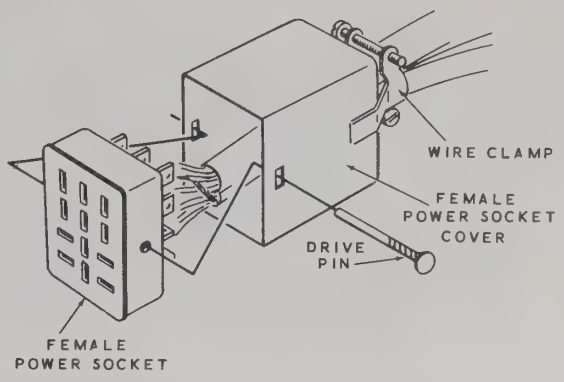
() Connect the inner lead of either coaxial cable to lug 12 (S-1) and the shield lead to the wire between lugs 1 and 2 (NS). Mark this lead as the Antenna Relay lead.

() Connect the inner lead of the remaining coaxial cable to lug 11 (S-1) and the shield lead to the wire between lugs 1 and 2 (S-2). Mark this lead as the ALC lead.

() Refer to Detail 16C and place the female power socket into the power socket cover. Line up the small holes in the socket cover with the holes in the socket. Insert the drive pin through the hole and lightly tap it in place.

() Tighten the screws on the socket cover clamp to secure the cables.

() Install a phono plug or appropriate connector on the free end of the RG-174 coaxial cables extending from the power socket.



Detail 16C

() Mount the high voltage cap on the free end of the high voltage wire coming from the AC Power Supply.

RESISTANCE CHECKS

The input coils are factory adjusted and do not require any further alignment.

Measure the resistance from the pins on the power plug to chassis ground. The following readings were taken with an 11 megohm input VTVM.

If any difficulty is encountered in obtaining any of the following resistance readings, refer to the In Case of Difficulty section on Page 37.

POWER PLUG PIN NUMBER	RESISTANCE MEASURED
1	0
2	0
3	0
4	inf.
5	inf.
6	0
7	inf.
8	inf.
9	inf.
10	over 3 megohms after 10 seconds
11	inf. after 3 seconds
12	over 3 megohms after 10 seconds

POWER PLUG PIN NUMBER	RESISTANCE MEASURED
Between pins 7 and 8	inf. power switch off 0 power switch on
Between pins 10 and 12	1500 Ω
HV socket to chassis	inf.
RF input socket to chassis	inf.
RF output socket to chassis	inf.
RF input socket to RF output socket	0

CAUTION: LETHAL VOLTAGES ARE PRESENT IN THIS UNIT. USE EXTREME CARE WHEN MAKING ANY TEST WITH THE POWER ON.

INITIAL TEST

NOTE: The following tests are made without high voltage from the Power Supply connected to the Linear Amplifier.

() Plug the power cable socket onto the POWER plug on the rear apron of the Linear Amplifier. Connect the other end of this cable to the Power Supply. DO NOT connect the high voltage lead.

() Connect the Power Supply to the appropriate power source. Turn ON the Linear. The pilot lamp and tube filaments should light.

NOTE: One of the tube filaments may glow brighter than the other. This is due to the tubes being connected in series and one tube having a slightly higher filament resistance than the other. This is within the manufacturer's specifications and will not affect operation of the Linear Amplifier.

() Using a 20,000 ohm/volt meter or VTVM, measure the voltage at pin 3 of tubes V1 and V2. This voltage should be approximately -120 volts DC, using the HP-14 and approximately -150 volts DC using the HP-24. If not, refer to the In Case Of Difficulty section on Page 37.

() Touch the center pin of the Antenna Relay coaxial cable to the chassis. CAUTION: DO NOT touch the center pin with your hand as it has -120 volts DC present. When this point touches the chassis the antenna relay should close.

() With the antenna relay closed, again measure the voltage at pin 3 of tubes V1 and V2. It now should be approximately -2 volts DC.

() Turn the power supply off and disconnect the power cable from the Linear Amplifier.

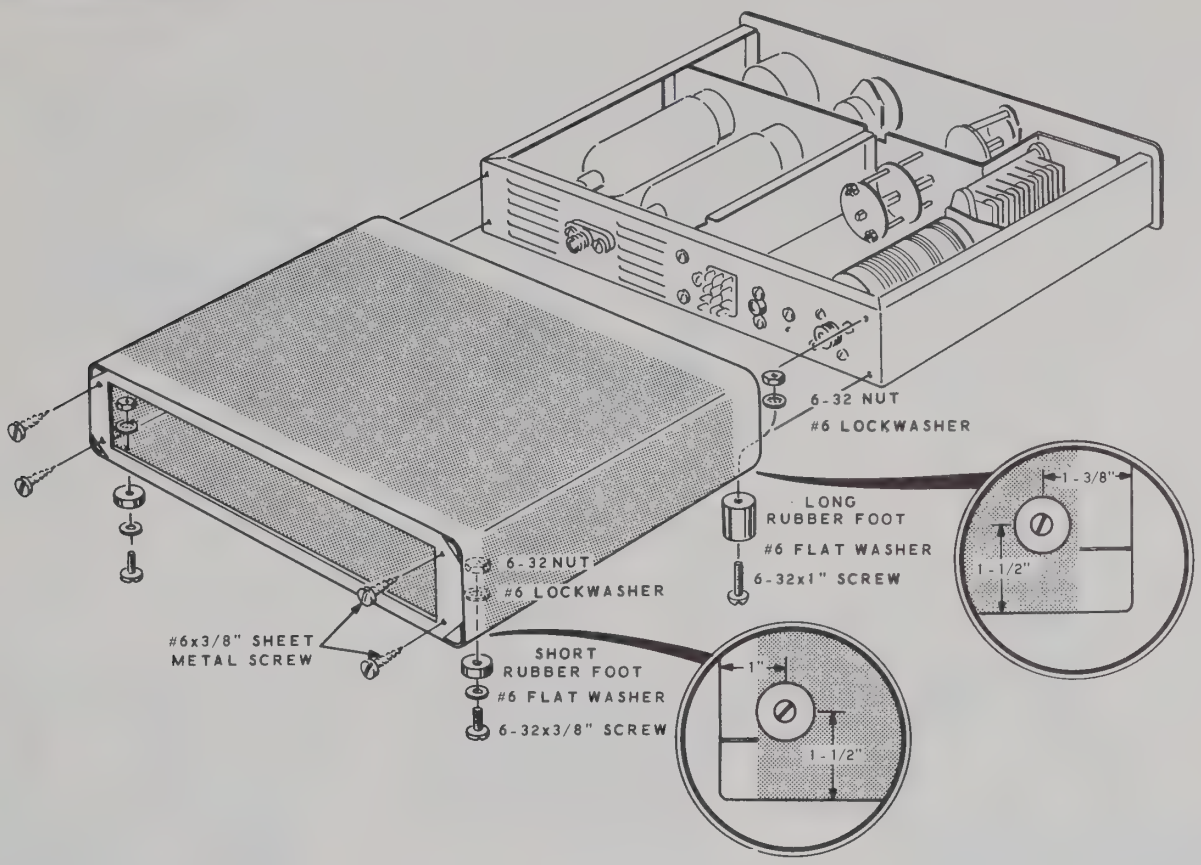
This completes the Initial Test. Continue with Final Assembly.

FINAL ASSEMBLY

Refer to Pictorial 17 for the following steps.

NOTE: Two different sizes of rubber feet are provided to permit various types of installations. The method described in this section permits a slight backward tilt of the Linear Amplifier for easy operation of the controls. Three different suggestions for mobile mounting are shown on Page 32. If the Linear Amplifier is mounted to another unit, use the short rubber feet and the 6-32 x 5/8" screws. The seams of the cabinet should be placed on the bottom.

() Mount a short rubber foot on each rear corner of the cabinet. Measure in from the side and rear of the cabinet as shown. Secure the feet with a 6-32 x 3/8" screw, a #6 flat washer, a #6 lockwasher, and a 6-32 nut. The screw passes through the perforated holes in the cabinet. These dimensions are approximate.



PICTORIAL 17

() Mount a long rubber foot on each front corner of the cabinet. Measure in from the side and front of the cabinet as shown. Secure each foot with a 6-32 x 1" screw, #6 flat washer, #6 lockwasher, and a 6-32 nut.

() Slide the chassis into the cabinet.

() Secure the chassis to the cabinet with #6 x 3/8" sheet metal screws.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

() Install the identification label in the following manner:

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the side of the chassis frame.

2. Carefully peel away the backing paper. Then press the label into position.

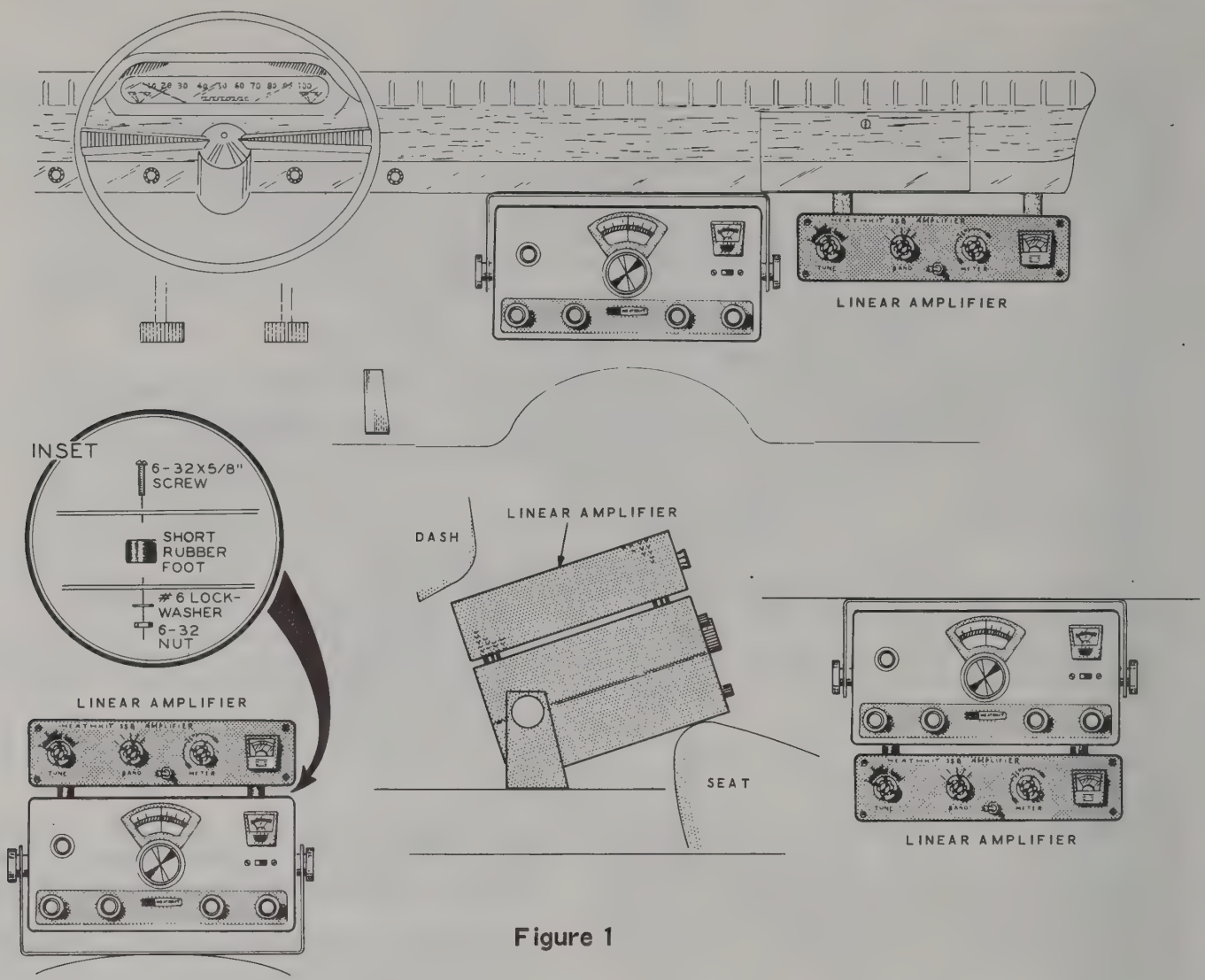


Figure 1

INSTALLATION

LOCATION

The tubes in the Linear Amplifier generate considerable heat, therefore, the unit should be mounted in a location that will allow good air circulation. This applies to both mobile and fixed station installations. Three suggested mobile installations are shown in Figure 1.

POWER SOURCE

The Linear Amplifier is designed to operate from a 2400 V DC voltage source. This can either be a transistorized mobile power supply or an AC fixed station supply. Use the proper power socket wired previously.

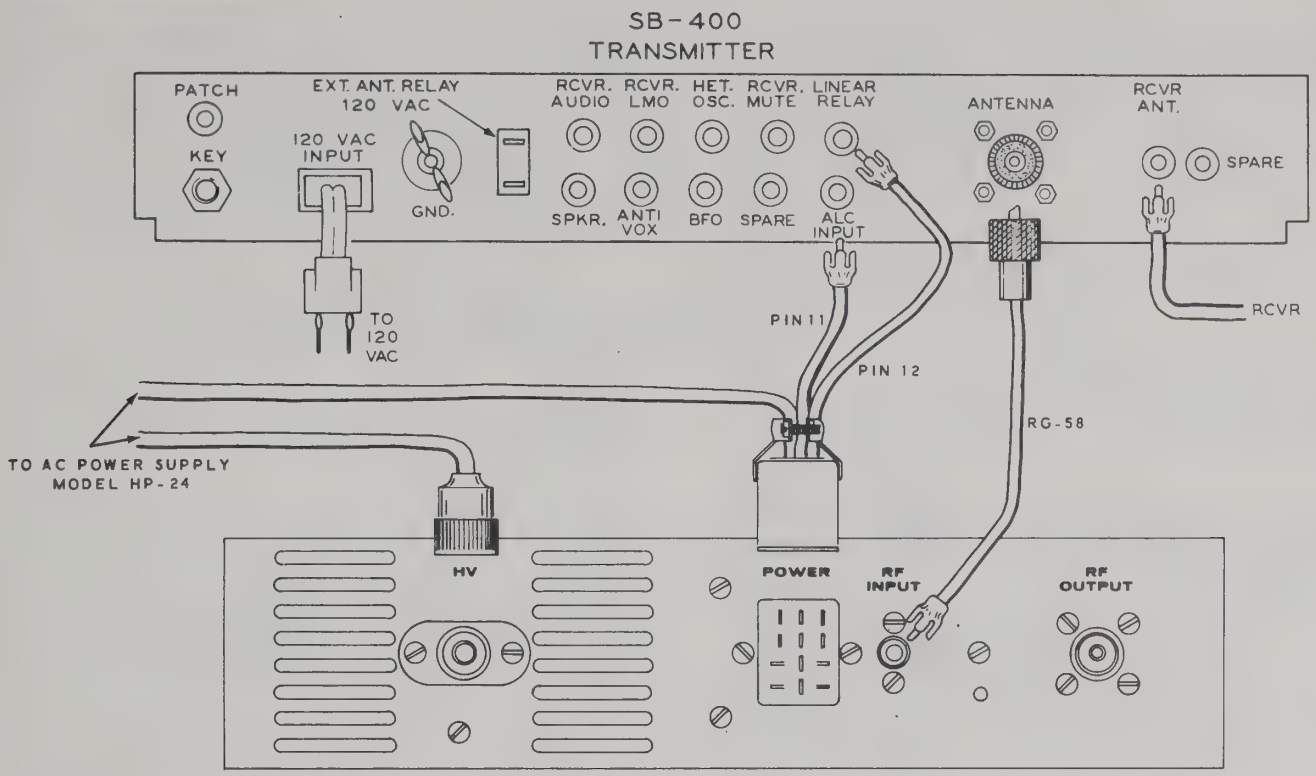


Figure 2

EXCITER

The Linear Amplifier can be driven by most commercial or home-built exciters with a power output of approximately 100 watts. The Heathkit HW-12, HW-22, and HW-32 Transceivers and the SB-400 Transmitter are ideal for use with this Linear Amplifier. Some modifications to the HW-12, HW-22, and HW-32 Transceivers are necessary. See Figure 3A. Exciters with an output in the 40 to 60 watt range can be used to drive the Linear Amplifier, however, the full power capabilities of the Linear Amplifier cannot be used.

ANTENNA

The pi-network output is designed to work into a 50 Ω line with an SWR not to exceed 2 to 1. Every effort should be made to get the SWR of the antenna down to less than 2 to 1.

A mobile antenna rated at 1000 watts is recommended for use with the Linear Amplifier. However, satisfactory results have been obtained from some antennas of a lower rating. If an antenna is used with less than a 1000 watt rating corona may appear at the tip of the antenna while it is being used. Corona can be eliminated by using a larger metal ball at the tip of the antenna.

WARNING! When there is RF output from the Linear during transmit, a high voltage appears on the antenna. Do not transmit when anyone is near the antenna.

INTERCONNECTIONS

Figure 2 shows how to connect the Linear Amplifier to the Heathkit SB-400 Transmitter.

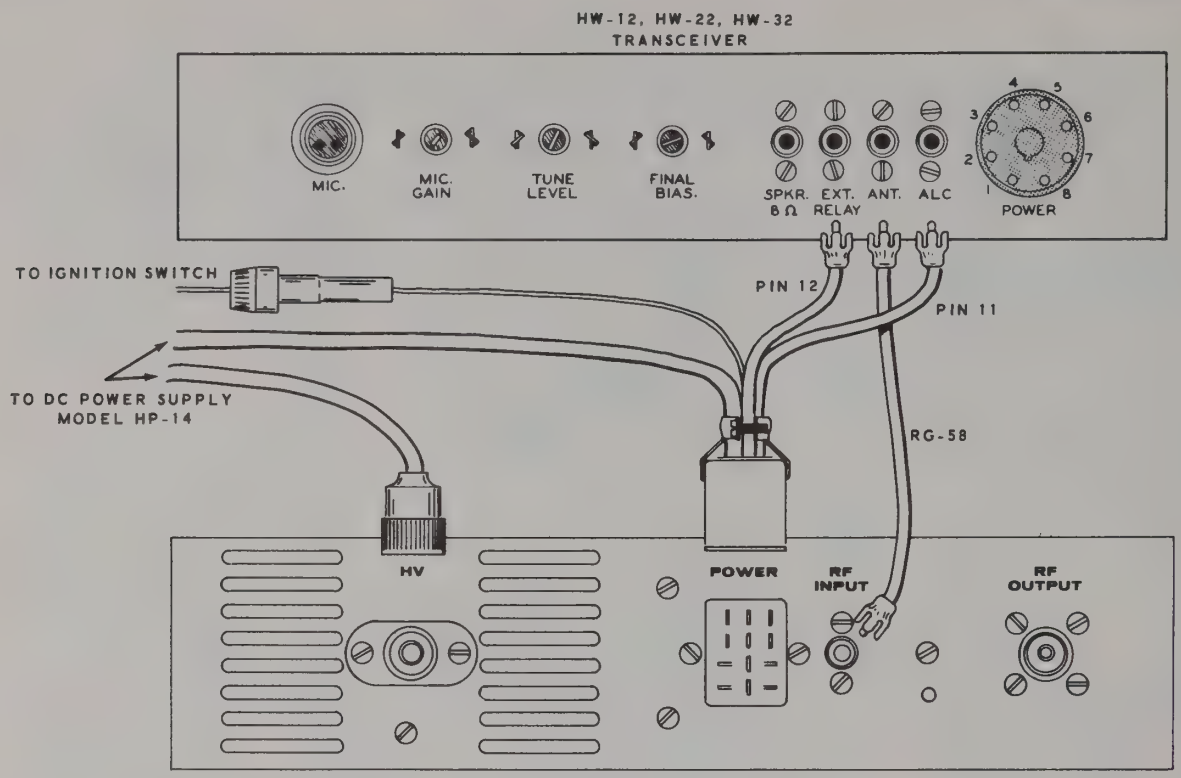


Figure 3

Figure 3 shows how to connect the Linear Amplifier to the Heathkit HW-12, HW-22, and HW-32 Transceivers. In order to use the Linear Amplifier with these Transceivers, it is necessary to slightly modify the Transceiver for external ALC. If the Linear Amplifier is used with a transceiver without ALC, wrap insulating tape around the phono plug to prevent shorting.

HW-12, HW-22, HW-32 Modification

NOTE: The Linear Amplifier has a built in antenna relay, therefore, the RCVR jack on the Transceiver is not needed. This jack will be used for the external ALC output. Refer to Figure 3A and the following instructions for this modification.

() Mount the 1-lug terminal strip, supplied with the Linear Amplifier, on one mounting screw of the RCVR jack as shown.

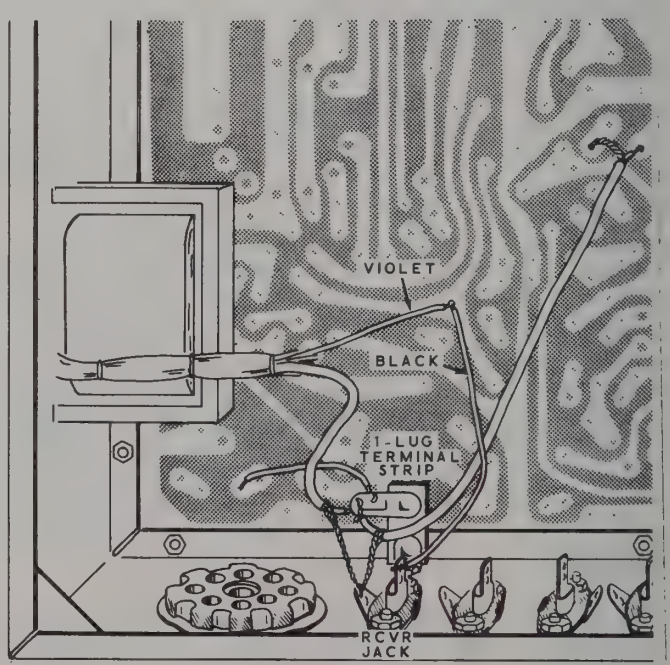


Figure 3A

() Remove the inner leads of the two coaxial cables and the black wire from lug 1 of the RCVR jack. Connect these wires to lug 1 of the terminal strip (S-3).

() Connect a 3-1/2" black wire from lug 1 of the RCVR jack (S-1) to the circuit board foil near terminal pin 7 (S-1).

() Change the lettering of this jack from RCVR to ALC. A grease pencil or marker pencil works very well for this.

This completes the modification of your Transceiver.

SWR MEASUREMENTS

() Connect the Linear Amplifier to the exciter and the antenna. Do not turn on the Linear Amplifier, thus permitting the exciter to feed through the Linear Amplifier to the antenna.

() Place the Linear Amplifier METER switch in the FWD position.

() Load the exciter to full output. The meter of the Linear Amplifier may be used for this purpose, as it will function in both the REL PWR and SWR positions without the Linear Amplifier being turned ON.

() Adjust the METER SENS control of the Linear Amplifier for a SET (full-scale) indication on the meter.

() Turn the METER switch to SWR and read the standing wave ratio directly from the meter (1 to 3 scale).

NOTE: SWR checks can also be made with the Linear Amplifier operating at full power (1000 watts); however, due to the nonlinear characteristics of crystal diodes in the SWR circuit, the most accurate SWR readings are obtained at low power (70 to 100 watt) levels using only the exciter. If the exciter alone will not give full scale relative power readings, the Linear Amplifier may be used, however, limit the drive from the exciter to no more than necessary.

OPERATION

SSB OPERATION

() Connect all leads between the Linear Amplifier, the exciter, and the power supply.

() Connect a dummy load or antenna to the RF OUTPUT socket on the Linear Amplifier.

() Set the exciter to the desired frequency.

() Set the Linear Amplifier BAND switch to the desired band.

() Turn on the exciter only. Load the exciter in a normal manner at the desired frequency. NOTE: With the Linear Amplifier turned off, the exciter output is fed through the Linear Amplifier to the RF OUTPUT jack. The FWD and SWR functions of the Linear Amplifier meter can be used in loading the exciter.

() Check the SWR of the antenna system as described previously.

() Reduce the drive level of the exciter to a minimum.

() Turn on the Linear Amplifier and apply a small amount of RF from the exciter. Peak the TUNE control for maximum REL PWR on the Linear Amplifier meter.

() Switch the exciter for SSB operation and set the microphone level to the desired level.

This procedure of tuning the Linear Amplifier should take only a few seconds, after you go through it a few times. The Linear Amplifier is now loaded for operation at maximum input power.

CW OPERATION

This Linear Amplifier, while designed for SSB use, can be used for CW operation with the Heathkit Model HP-24 AC Power Supply. The duty cycle must not exceed the normal telegraphy duty cycle of 33% maximum.

For CW operation, the Linear is tuned the same as for SSB operation, except that the exciter is set for CW operation. The exciter output should be increased to maximum output (approximately 100 watts) and keyed.

PEAK ENVELOPE POWER MEASUREMENTS

Peak Envelope Power (P.E.P.) can not be measured on a wattmeter, because the ballistics of the meter will not follow the peak power excursions of a voice modulated SSB envelope. The following paragraphs describe a method of measuring P.E.P. Here, a CW signal is used in conjunction with a wattmeter to calibrate an oscilloscope. The oscilloscope, a Heathkit HO-10 Monitor Scope in this example, is then used to measure P.E.P.

CALIBRATION

Connect the Monitor Scope, dummy load, and wattmeter to the output of your HA-14 Linear Amplifier as shown in Figure 4. The power for the HA-14 must be furnished by the HP-24 AC Power Supply, since the HP-14 DC Power Supply is not designed for CW operation. (The HP-14 is designed to be self-protecting, and will limit CW power to a very low level. The dynamic regulation of this DC Supply, however, allows it to supply the very high peak currents that are needed for SSB operation.)

Tune the exciter to produce a 100 watt CW signal. Tune the Linear Amplifier for maximum output; the wattmeter should read between 500 and 600 watts. The Monitor Scope will now show a vertical deflection proportional to the voltage that this maximum output (500 to 600 watt) CW signal develops across the (50 Ω) dummy load.

Use a grease pencil to mark the vertical size (or make a mental note of the size) of this signal on the Monitor Scope. See X in Figure 4.

NOTE: The sensitivity of an oscilloscope decreases as the input frequency increases. Therefore, the Monitor Scope should be recalibrated when it is switched to a different band.

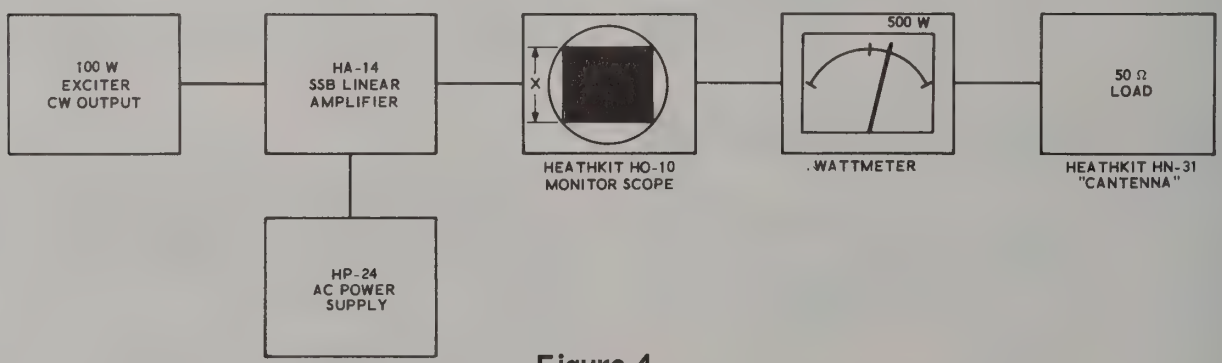


Figure 4

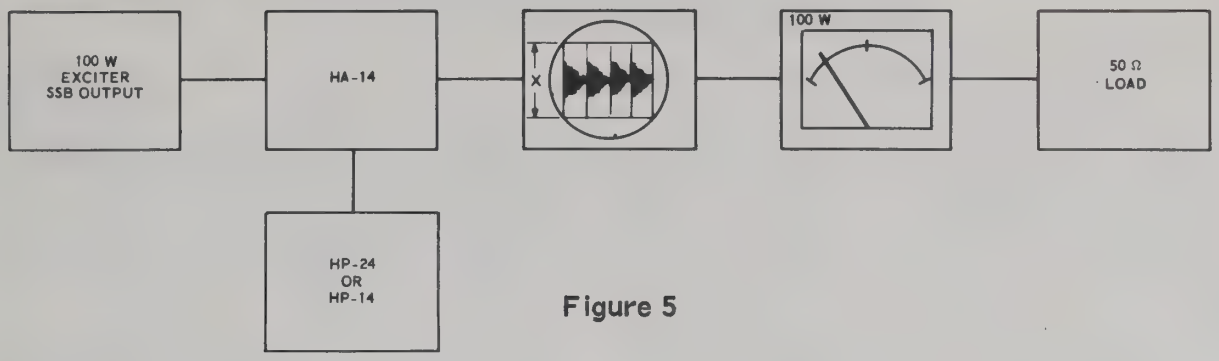


Figure 5

P.E.P. MEASUREMENT

NOTE: Figure 5 shows a P.E.P. measurement being made. The connections are the same in Figure 1, except that here, either an AC or a DC Power Supply can be used.

Switch the exciter to SSB, and voice modulate it. The peaks of the voice modulated signal will show up as vertical deflection on the Monitor Scope.

The P.E.P. can now be determined by comparing the voice peaks to the size of the maximum output CW signal previously viewed on the Monitor Scope. If these peaks, for example, are the same height as the maximum output CW signal, the P.E.P. will be equal to the maximum output of 500 to 600 watts. See X in Figures 4 and 5. The wattmeter in this case would only read the average DC power output of about 100 watts.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.

3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.

4. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

5. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

6. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

7. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE
Tube filaments and pilot lamp do not light.	1. Power plug or sockets incorrectly wired. 2. Open circuit breaker in power supply. 3. Tube filaments and pilot lamp wiring incorrect. NOTE: Tube filaments are connected in series. If one opens, neither will light.
Antenna relay will not close when exciter is keyed.	1. No bias voltage (-120) to relay. 2. No ground between pin 12 of power socket and exciter in keyed position.
No forward or reflected power reading on Linear Amplifier meter.	1. Wiring error on Meter switch. 2. Wiring error on SWR coaxial cable. 3. Shielded leads shorted. 4. Defective diodes D2 and/or D3.
Output will not peak on some or all bands.	1. Band switch in wrong position. 2. 80-40-20 meter final coil incorrectly mounted and wired. 3. Tubular capacitors interchanged.
All power to Linear Amplifier turns off in mobile operation.	1. Overdriving from exciter. 2. The microphone level setting on the exciter is too high. 3. Defective 40 ampere circuit breaker in power supply.
In mobile operation, antenna relay keeps dropping out on voice peaks.	1. The microphone level setting on the exciter is too high. 2. No ALC voltage being applied back to the exciter. 3. Exciter ALC circuit not operating. 4. Corroded battery connections causing a high resistance connection.

SERVICE INFORMATION

SERVICE

If, after applying the information in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units, and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit Model Number and Series Number, and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed equipment to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service. HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from the Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally, improper operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the kit Model Number and Series Number.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan 49022

ATTACH A LETTER TO THE OUTSIDE OF THE CARTON BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Also, include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

SPECIFICATIONS

Band Coverage	80, 40, 20, 15, and 10 meters.
Maximum Power Input	SSB: 1000 watts P.E.P.
Driving Power Required	100 watts.
Duty Cycle	SSB: 50% voice modulation.
Third Order Distortion	-30 db or better at 1000 watts P.E.P.
Output Impedance	50 Ω unbalanced. SWR not to exceed 2:1.
Input Impedance	52 Ω unbalanced; broad-band pretuned input circuit requires no tuning.
Meter Functions	0-6 relative power. 1:1 to 3:1 SWR.
Front Panel Controls	Tune: 80, 40, 20, 15, and 10 meters. Band: 80, 40, 20, 15, and 10 meters. Relative Power Sensitivity control. Meter switch: FWD and SWR. Power switch: OFF, ON.
Tube Complement	Two 572-B (or two T160-L) in parallel.
Power Requirements	2000 V DC at 500 ma SSB peak, -120 V DC at 60 ma, an 12.6 V DC at 4 amperes.
Cabinet Size	12-3/16" wide x 3-3/16" high x 10" deep.
Net Weight	7 lbs.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic (fold-out from Page 43) while reading this Description. The Linear Amplifier is basically made up of three circuits: Input Circuit, Output Circuit, and the Antenna Change-Over and CutOff Bias Circuit. Each circuit is described individually.

INPUT CIRCUIT

Tubes V1 and V2 are connected in parallel in a cathode-driven (grounded grid), class B configuration. Driving power for each band is coupled through a broad-band network, consisting of a coil and associated capacitors, and through capacitor C13 to the cathodes of tubes V1 and V2. Coils L1 through L5 with their associated capacitors are used to make up these impedance-matching networks, which reduce distortion and increase efficiency.

The correct input network, as well as the correct output circuit coil tap, for each band is selected with the Band switch. (The coils in the input networks are factory aligned.)

To keep the capacitance of the filament supply from shunting the RF driving power to ground, the filament winding is isolated from the cathode circuit by a bifilar-wound filament choke. Also, this choke provides a cathode current path to ground.

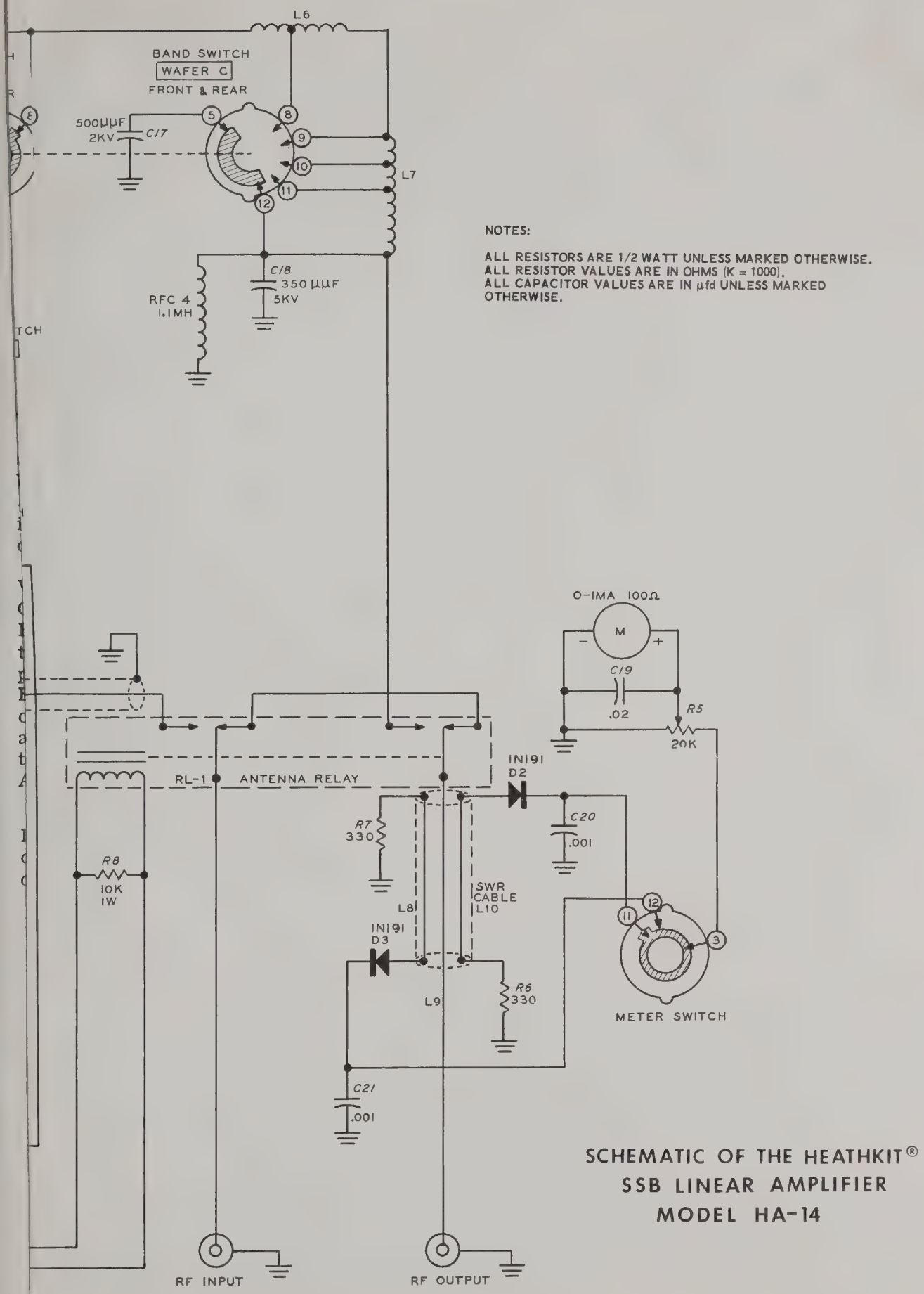
OUTPUT CIRCUIT

High voltage is applied to the plates of tubes V1 and V2 through RF chokes RFC1 and RFC2 and parasitic chokes PC1 and PC2. Tuning capacitor C15 is connected on the input side of tapped final coils L6 and L7. C16 is switched in parallel with the Tuning capacitor on the 80 meter band.

Loading capacitor C18 is on the output side of final coils L6 and L7. Capacitor C17 is switched in parallel with the Loading capacitor on the 80 meter band. Output power is applied through antenna change-over relay RL1 and through the SWR (standing wave ratio) bridge circuit to the RF Output connector. The SWR bridge consists of coils L8, L9, and L10, capacitors C20 and C21, resistors R6 and R7, and crystal diodes D2 and D3. RF choke, RFC4, is connected from the output side of the final coils to ground to provide a direct DC to ground path in case capacitor C14 should short.

ANTENNA CHANGE-OVER, ALC, AND CUTOFF BIAS CIRCUITS

Antenna change-over relay RL1 is controlled by a VOX (voice operated transmitter) relay in the Exciter used with the Linear Amplifier. The relay in the Exciter is connected to the Antenna Relay lug (12) on the power plug of the Linear Amplifier. When transmitting, the VOX relay grounds the Antenna Relay; when receiving, the Antenna Relay is ungrounded.



SCHEMATIC OF THE HEATHKIT®
SSB LINEAR AMPLIFIER
MODEL HA-14

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The correct input network, as well as the correct output circuit coil tap, for each band is selected with the Band switch. (The coils in the input networks are factory aligned.)

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While receiving, cut-off bias voltage from the power supply is applied through the coil of relay RL1, and through resistors R2, R3, and R4 and choke RFC3, to the grids of tubes V1 and V2. The Antenna Relay lug is ungrounded and no current will flow through the coil of relay RL1, which allows the relay to remain open. Thus it connects the RF Output jack (antenna) to the RF Input jack of the Linear Amplifier.

When transmitting, the Antenna Relay lug (12) is grounded by the VOX relay of the exciter. This allows current to flow through the coil of relay RL1 and actuate the relay. When actuated, relay RL1 connects the RF Output jack (antenna) to the output circuit of the Linear Amplifier. Grounding the Antenna Relay lug also grounds the grids of tubes V1 and V2 through RFC3, and resistors R3 and R4. This removes all but -2 volts from the grids of the tubes. This -2 volts which is developed across resistor R9 is operating bias, which limits resting plate current to approximately 90 milliamperes.

When operating with the Linear Amplifier turned Off, there is no bias voltage to operate relay RL1 and the RF Input jack remains connected to the antenna, through RF Output jack. This permits low power operation directly from the Exciter into the antenna without changing any cables. Because instant-heating-filament tubes are used in the Linear Amplifier, you can go to high power operation as soon as the Linear Amplifier is turned On.

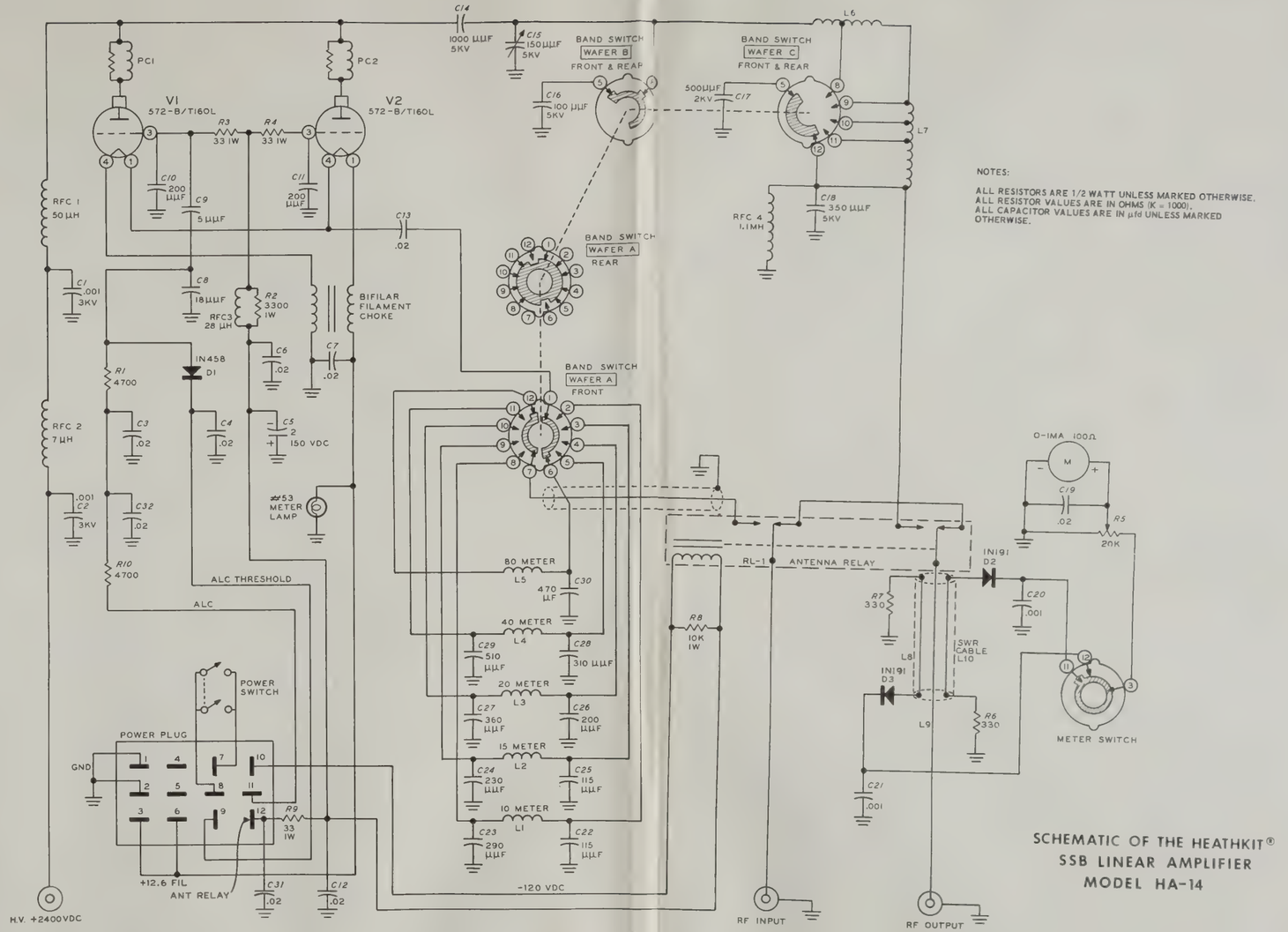
During modulation the ALC control voltage is developed across a voltage divider that consists of capacitors C8 and C9. A sample of this voltage is rectified by diode D1. Diode D1 is reverse biased with approximately +6 V DC to form a threshold level. A negative DC control voltage is produced that is proportional to the modulation level. This control voltage is then applied back to the ALC input of the exciter.

Relative Power and Standing Wave Ratio are measured with a bridge circuit consisting of coils L8, L9, and L10, diodes D2 and D3, resistors R6 and R7, and capacitors C20 and C21. Relative Power Sensitivity control R5 sets the sensitivity of the meter. The FWD position is used when adjusting the Tune control for maximum output of the Linear Amplifier; this meter function is also used to establish a "set" meter level for making SWR measurements.

Because coil L9 of the bridge circuit is connected in series between the RF Input and RF Output jacks when the Linear Amplifier is turned off, the meter can be used to measure relative power and SWR when operating the Exciter alone. This method of checking SWR is recommended for accurately determining antenna performance.

In the bridge circuit, RF current is inductively and capacitively coupled from L9, to L8 and L10. The RF currents in L8 and L10 are rectified by diodes D2 and D3, and then filtered by capacitors C20 and C21.

For relative power measurements, the rectified RF voltage from L10 is applied to the meter. For SWR (reflected power) measurements, the rectified RF voltage from L8 is applied to the meter.



SCHEMATIC OF THE HEATHKIT®
SSB LINEAR AMPLIFIER
MODEL HA-14

WARRANTY

The Heath Company warrants that the parts supplied in its kits (except batteries) shall be free of defects in materials and workmanship under normal conditions of use and service. The obligation of Heath under this warranty is limited to replacing or repairing any such part upon verification that it is defective in this manner. This obligation is further limited to such defective parts for which Heath is notified of the defect within a period of ninety (90) days from the original date of shipment of the kit.

The obligation of Heath under this warranty does not include either the furnishing or the expense of any labor in connection with the installation of such repaired or replacement parts. The obligation of Heath with respect to transportation expenses is limited to the cost of shipping the repaired or replacement parts to the buyer, provided such repair or replacement comes within the terms of this warranty.

The foregoing warranty extends only to the original buyer and is expressly in lieu of all other warranties, expressed or implied. The foregoing warranty is further in lieu of all other obligations or liabilities on the part of Heath and in no event shall the Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or use of the kit product or components thereof.

The foregoing warranty shall be deemed completely void if acid core solder or paste flux or other corrosive solders or fluxes have been used in assembling or repairing the kit product. Heath will not replace or repair any parts of any kit products in which such corrosive solders or fluxes have been used.

This warranty applies only to Heath products sold and shipped to points within the continental United States and to APO and FPO shipments. Warranty replacement for Heath products sold or shipped outside the United States is on an f.o.b. factory basis. Contact the Heath authorized distributor in your country or write: Heath Company, International Division, Benton Harbor, Michigan, U.S.A.

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